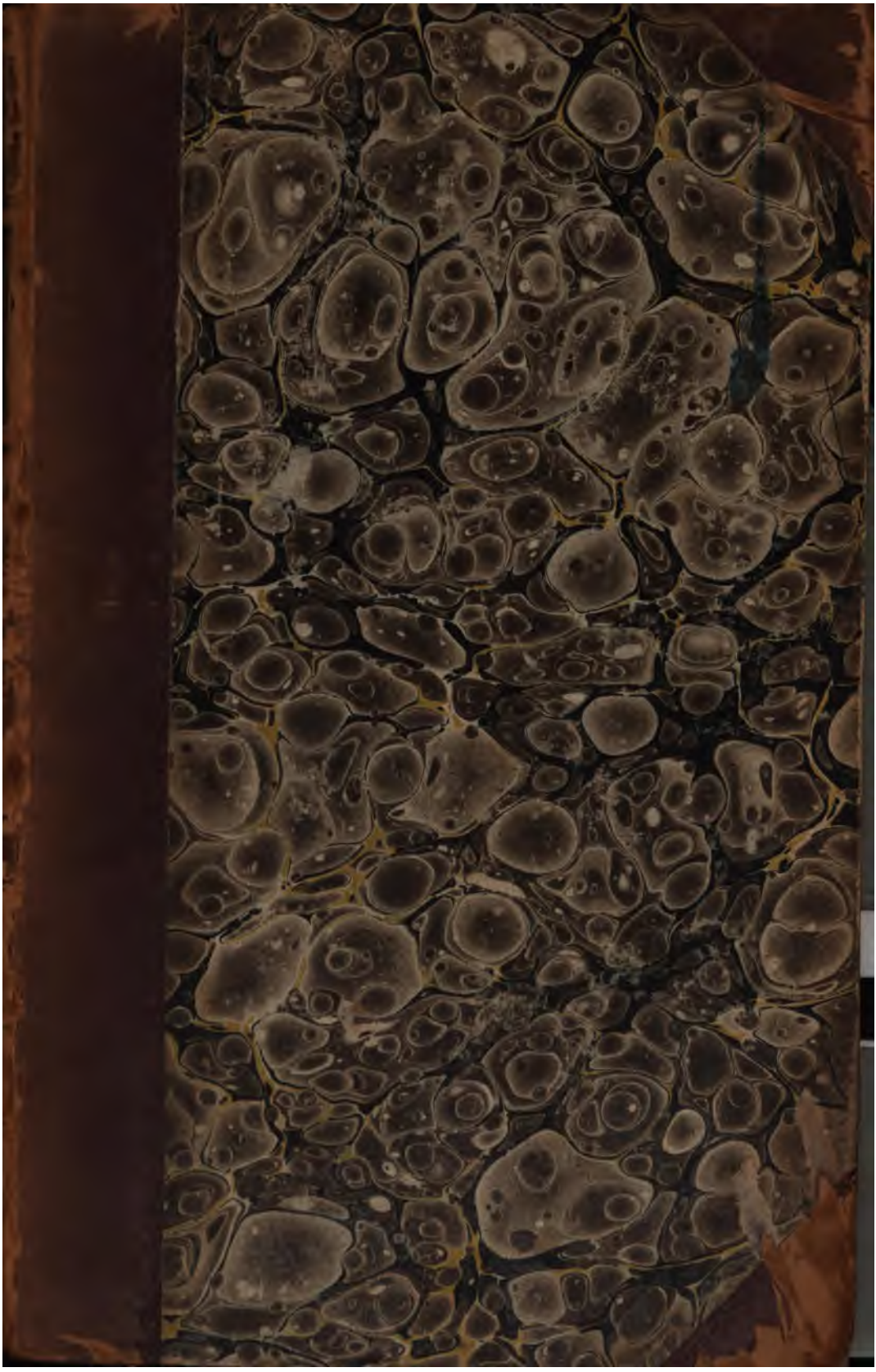

INTRODUCTORY LECTURES

TO A

COURSE OF ANATOMY,

DELIVERED BY THE LATE

JOHN BARCLAY, M.D. F.R.S.E.

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS, AND HONORARY FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF EDINBURGH, FELLOW OF THE LINNEAN SOCIETY, AND OF THE WERNERIAN NATURAL HISTORY SOCIETY OF EDINBURGH, &c. &c.

WITH A

MEMOIR OF THE LIFE OF THE AUTHOR,

By GEORGE BALLINGALL, M.D.

REGIUS PROFESSOR OF MILITARY SURGERY IN THE UNIVERSITY OF EDINBURGH.

EDINBURGH:

MACLACHLAN AND STEWART, EDINBURGH;

AND BALDWIN, CRADOCK, AND JOY, LONDON.

M.DCCC.XXVII.

PRINTED BY JAMES CLARKE AND CO.
OLD STAMP OFFICE.

TO

JOHN DICKSON, ESQ.

SURGEON IN THE ROYAL NAVY, &c.

TO ROBERT NASMYTH, ESQ.

FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF EDINBURGH;

AND

TO THOSE GENTLEMEN WHO SUCCEEDED HIM AS ASSISTANTS TO DR. BARCLAY.

GENTLEMEN,

THE duty of editing the Introductory Lectures of our lamented Master having devolved upon me, I can think of no Body of Men to whom these Lectures can be inscribed with greater propriety than to you, who preceded, and who followed me, as assistants to Dr. Barclay in the labours of his Class,—to you, whose professional prosperity was to him a source of constant and anxious solicitude,—to you, whose eminence in different branches of the profession was to him a

source of honest exultation. "When you wish me," said he, "that kind of reward arising from the number, the respectability, and the usefulness of my pupils, you wish me, indeed, a kind of reward of which I feel that my heart would be proud." To you, then, Gentlemen, I beg leave to dedicate this volume, with every sentiment of respect and esteem.

I have the honour to be,

GENTLEMEN,

Your most obedient servant,

GEO. BALLINGALL.

COLLEGE OF EDINBURGH,
7th November, 1827.

ADVERTISEMENT.

THE greater part of the following Lectures was printed previous to Dr. Barclay's death, and his executors having, in fulfilment of the Doctor's obvious intention, determined to complete the Work, it is now offered to the Public as containing a valuable abridgment of the History of Anatomy, and as likely to prove acceptable to numerous Members of the Medical Profession, who feel a pride in being ranked amongst Dr. Barclay's pupils.

Dr. Ballingall having been requested to superintend the Publication, and to furnish a Memoir of the Life of his distinguished Friend, has had great pleasure in complying with the wishes of the Executors. He begs to offer his acknowledgments to several of Dr. Barclay's friends, and particularly to the

Reverend Mr. Burgh of Trinity Gask, from whom much of the information embodied in the following Memoir has been obtained. This Memoir Dr. Ballingall commits to the press, in the fullest confidence that he will experience the indulgence of his Profession and of the Public, when engaged in a species of writing so foreign to his usual pursuits.

QUEEN STREET,
Edinburgh, 7th November, 1827.

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ERRATUM.

Page xviii. line 8—*for* "his speech became much impaired," *read*, "his speech *latterly* became much impaired."

THE

LIFE OF DR. BARCLAY.

THE subject of the following Biographical Sketch, affords one of those numerous instances so creditable to our country, in which an individual, inheriting nothing from his parents except a sound constitution, a vigorous mind, and a virtuous education, has subsequently risen, by his own exertions, to such a degree of eminence in science, as to render the particulars of his life interesting to his surviving friends, and useful as an example to posterity.

Dr. Barclay was born in the year 1759 or 1760, at the farm of Cairn near Drummaquhance in Perthshire, and at a very early age was removed to Strageath, a farm on the property of Lord Gwydir, in the same county, which is still occupied by his sister and her husband, Mr. M'Crosty. While residing here, he received the rudiments of his

years afterwards, of accompanying the Doctor in search of his benefactors, and of witnessing the very gratifying recognition on both sides; the Doctor giving them substantial proofs of his recollection of their kindness.

Having finished his course of study at the University, Dr. Barclay was licensed as a preacher of the Gospel, by the Presbytery of Dunkeld, and was for some time employed as tutor in the family of Charles Campbell, Esq. of Loch Dochart. Here he prosecuted, at his leisure hours, the study of natural history, and made some interesting observations upon insects. He afterwards entered into the family of the late Sir James Campbell of Aberuchill; and, at the commencement of the winter session 1789, he proceeded with his pupils, Mr. William, and Mr. Frederick Campbell, to Edinburgh.

Soon after this he began to give his attention to the study of Medicine, and particularly to Anatomy, both human and comparative, continuing, at the same time, to give assistance, in the way of his original profession, to some of his friends amongst the clergy of Edinburgh and its neighbourhood. He preached occasionally for the late Dr. Hardy, and for Mr. Grant of Libberton, who had been his class-fellow at St. Andrew's, and with whom he continued in habits of intimacy up to the period of his death. The study of physic, however, and particularly the many interesting subjects of anatomical research, so well suited to Dr. Bar-

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any avoidable expense on his pupils. His liberality indeed, to young men struggling with adverse fortune and straitened circumstances, was one of the most conspicuous traits in his character, and was thought by some to have been carried even to a fault. He gave many young men gratuitous admission to his own lectures; and has even been known to furnish them with the means of feeing other teachers.

We would now proceed briefly to notice some of Dr. Barclay's principal writings, and of these, we think, the bare enumeration is nearly all that is requisite, as they have been successively noticed in the periodical publications of the day, and are well known to the better informed members of the profession. His first contribution to the literature of medicine was, we believe, the article PHYSIOLOGY, which he furnished for the Encyclopædia Britannica, and which was calculated to raise his character as a man of science.

In 1803, soon after he commenced his career as a teacher, Dr. Barclay attempted a reform in the language of Anatomy, with a view to render it more accurate and precise; a task for which his acquirements, as a classical scholar, rendered him peculiarly fit. Although the "Nomenclature," which he published upon that occasion, has not yet been universally adopted, we believe that the Profession, with one voice, acknowledges the importance of

the object which he had in view, and the talent and learning with which it was executed.

Some of his illustrations of the defects in the existing language of Anatomy, particularly in the terms expressive of position and aspect, were peculiarly striking, and highly characteristic of his overflowing humour: "The terms *above*, *below*, "*behind*, and *before*," he used to observe, "would "be sufficiently definite, if the body was uniformly "to preserve the same position; and so," said he, "would be the expression in Hudibras, where the "author makes Crowdero apply a squeaking engine "to the *north-east* side of his neck: this would be "sufficiently definite, if one could ascertain, by "compass, in what particular position the fiddler "stood."

His next work, published in 1808, was a Treatise on "The Muscular Motions of the Human Body," calculated to encourage a more attentive study of the simple and combined actions of the muscles, with a view to a more scientific and successful treatment of fractures and luxations; a department of surgery, which, even now, although illustrated by his distinguished friend Sir Astley Cooper, can scarcely yet be said to be rescued from those popular prejudices under which it has so long laboured.

In 1812, Dr. Barclay published the first edition of his "Description of the Arteries of the Human

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tended to be presented to the Royal College of Surgeons, to which learned body Dr. Barclay bequeathed his Museum.

This Museum, to which the Doctor devoted much of his time and attention, was collected at a very considerable expense, and was enriched by contributions from his numerous pupils, now dispersed over the various quarters of the globe. It contains a very valuable collection of specimens in Comparative Anatomy, and some of the finest vascular preparations which are anywhere to be seen. It was made over to the College with the avowed purpose of preventing it from being broken up and scattered after his death; upon condition that it should be allowed to retain his name; and that it should be devoted to purposes of professional utility. We have reason to expect that it will soon be placed by its new proprietors, in a situation calculated to arrest the public attention, to benefit the medical profession, and to evince the unwearied zeal and activity which enabled Dr. Barclay to bring it together without the aid of public patronage, of private fortune, or official influence.

Dr. Barclay's entire devotion to the teaching of Anatomy did not permit his engaging, to any extent, in the practice of his profession, although he was frequently consulted by some of our best surgeons in cases of difficulty, where

home in superintending the printing of the first part of these Lectures, and in writing the Lives of Aristotle and of Harvey, two of his favourite authors: these, however, were not left sufficiently complete to be given to the world. In the course of the following spring and summer, Dr. Barclay fell off rapidly, without any very marked disease; his speech became much impaired, evidently from a paralytic affection. He was subject to occasional attacks of dyspnœa, and these recurred in paroxysms, so as to lead him to consider his complaints as asthmatic. For several weeks previous to his death, he was so much debilitated as to be constantly confined to bed, was able to take very little sustenance, and sunk exhausted on the 21st of August, 1826.

During his illness, the Doctor was constantly watched and assiduously nursed by Mrs. Barclay, who lives to lament his loss. He was attended professionally by his eminent and esteemed friend Dr. Hamilton, Sen. by his brother-in-law Dr. John Campbell, and by the author of the present brief and imperfect sketch of his life, who, while employed for several years as his assistant, had frequent opportunities of witnessing his many estimable private virtues; but from any attempt to delineate these, he is deterred by the conviction that he owes too much to his deceased friend and master, to consider himself, or to be looked upon by others, as an impartial judge.

Dr. Barclay's remains were interred at Restalrig, near Edinburgh, the family burying-ground of his father-in-law, Sir James Campbell. His funeral was attended by a large circle of private friends, and by the Royal College of Surgeons as a body; anxious to testify their respect for his character, and their gratitude for the splendid bequest by which he has enriched their anatomical treasures.

LECTURE FIRST.

ANATOMY is a word which, in strict etymology, signifies Dissection, but is now used, in a general sense, for that art, in which, not only by means of the knife, but any species of instrument or contrivance, we demonstrate the structure of organized bodies. It is also used for a knowledge of the objects about which that art is employed. With a reference to man, it is called Human Anatomy; with a reference to the lower animals, Comparative; and when used to discover either the cause or effects of disease, is generally distinguished by the epithet of Morbid.

As art or science, it is not only interesting in itself, but various and extensive in its application. Its great importance to the surgeon and physician, who wish to be either useful to society, or acquire eminence in their profession, was early and universally acknowledged. Without its aid, we can neither trace the causes of symptoms, operate skilfully on the living body, or investigate morbid appearances in the dead.

In the pursuits of the naturalist, it was soon found by the ingenious and illustrious Aristotle to be equally indispensable; as, by it, we discover, in the form and structure, many of the causes of the temper, genius, manners, and habits of the animal kingdom.

To the painter and statuary, who propose to imitate animated nature, its advantages are so obvious, that anatomical plates have again and again been published for their use; and, it has been alleged, that many have owed no small share of professional eminence to their previous acquaintance with this art.

The courses of Lectures on Medical Jurisprudence, sufficiently shew, of what importance it is to the lawyer. Without a knowledge of the animal structure, the judge, in a number of criminal trials, is

incompetent to decide on the nature of the facts; and it sometimes has happened, that the counsel for the pannel, or what in England is called the defendant, from not knowing the nature of the questions which he proposed, has inadvertently become evidence against his client. At any rate, when the case is such, that the pannel must stand acquitted or condemned, not upon the simple evidence of facts, but upon the opinion that is formed of their consequences, the decision must be regulated by some person acquainted with the nature of the animal economy; and, for this reason, not only have the decisions of a court, but the laws of a nation, been sometimes founded on medical opinion. We are told by Le Clerc, that a law to determine, whether children, in certain cases, be legitimate or spurious, has been enacted in some countries merely upon the opinion of Hippocrates, and in a case where Hippocrates himself was evidently misled by the Samian philosopher's doctrine of numbers.

To the Physico-Theologist I need scarcely mention the numerous advantages that his studies may derive from a knowledge of the animal structure. Many of the ancients, and " particularly Cicero, have, from this source, derived more arguments in

proof of the existence, wisdom, and providence of a Deity, than from all the productions of nature besides." And, it will be found, that these proofs not only exceed the others in number, but surpass them far in the clearness and force by which they impress conviction on the mind, confirm the sentiments of rational piety, and induce the habits of religion and virtue. My intention, however, is not to enumerate all the advantages which ingenious men of different professions may derive from anatomy;—many more than what I have suggested will present themselves on a more close inspection of the subject: for the animal structure, to say the least of it, is singularly curious; it affords an almost exhaustless fund of useful instruction, and has, besides, frequently conferred an immortal honour on those accurate observers who have examined it with patience and success.

As I mean to give a short account of the principal discoveries that have been made in this branch of science, the present Lecture will be confined to a general description of those organs of which the human fabric is composed. We shall thus be much better prepared for the History of Anatomy,—shall trace its progress with more advantage and be better,

enabled to estimate justly the respective merits of those, who, by industry, genius, or accident, have advanced its improvement.

Some general view of this kind being usually given before entering on particular description, many authors have contented themselves with defining the principal technical terms that occur in the art: but the late Dr. Hunter, disliking this method, as tedious and dry, and as not admitting his display of talents, has, in order to give an idea of the system, explained the manner in which he thinks that a man might be made. "Let us," says he, in the confidence of his heart, "let us make a man." This man is accordingly made in one of his Lectures. But though this man, like that of De Cartes, does much credit to his genius and fancy, he turns out to have no more an intrinsic resemblance to the original, than a statue or picture has to real life. In making this man, he has neither regarded the processes of nature, nor followed the usual order of demonstration; and, on that account, although he has succeeded in amusing his reader, he has not communicated that important instruction which a faithful narration of facts would have furnished.

I would fain hope, that the account which I am

now to give, will be more entertaining than a number of dry unconnected definitions, not easily remembered, and more instructive than any anatomical fiction whatever. The difficulty is how to begin. As all the parts of the human body are mutually dependent on one another, and as we must return to the same point from which we set out in the description, on a cursory view, it may seem indifferent where we begin. Experience, however, and observation have shown, that we commence at one point with much more advantage than at another; and, therefore, the general and most approved order of demonstration shall, in this instance, determine the choice; for there is certainly some advantage in adhering to the same method of arrangement: it does much to prevent confusion, to assist the memory, and facilitate afterwards a clear and accurate comprehension of the subject.

Now the first parts to which the attention is usually directed in a Course of Anatomy, is the Bones, and that branch which treats of these organs is styled Osteology,—a branch of Anatomy of much more importance in Surgery, Physic, and Natural History, than is generally supposed. According to Winslow, Albinus, Monro, and indeed every distinguished anatomist, it is the foundation of the

whole science, without which no lasting structure can be raised.

In the adult or grown-up subject, the bones are the hardest and most solid parts of the whole system, and, though not the only, are the principal parts that give it form, stability, and posture. At birth, many are soft, flexible, transparent, with scarcely any osseous matter; others contain several portions of this matter to be afterwards extended; and others their full and ultimate proportions which they have at the advanced periods of life. One set of them, called the Temporary Teeth, twenty in number, are shed in the latter periods of infancy; reckoning the thirty-two which succeed, with the other bones belonging to the skeleton, the whole amount, in the human subject, to about 245.

As they give form, stability, and posture, we must suppose them to be somehow connected. Upon examination, we find them connected by unequal surfaces, whose cavities and eminences mutually correspond; these connections are called Articulations, and are naturally divided into three kinds. The first, admitting of a free, easy, and conspicuous motion; the second, of a motion that is rather obscure; and the third, of a motion that is next to imperceptible: these three kinds, with their species

or branches, to be afterwards described, are about nine.

As the rough surfaces, however, of bones, will not allow them to move on one another without great friction, in all cases where motion is either frequent or extensive, there ought to be some intervening substance. We accordingly observe, in the recent subject, that all those articulating surfaces, where any extensive motion takes place, are covered with a smooth and elastic substance, of a pearl colour, known in our language by the name of Gristle, but in Anatomy, by that of Cartilage,— a substance which, independent of its smoothness, is lubricated by a fluid that is called Synovia, and which performs, to the different joints, the same office that oil does to a piece of machinery.

As the bones, however, must be restricted in their range of motion, we must also suppose, that there are means by which that end is to be accomplished. Upon inspection, we perceive that some are prevented from changing their relative situation by certain modes of articulation; while others, where a slight motion is permitted, are united by cartilage; and others, where extensive motion is allowed, connected by ligaments, membranes, or flesh.

The organs called Ligaments, are flexible substances, of a fibrous texture, of a whitish colour, glistening appearance, and of little elasticity: they occur in a great variety of forms, situations, and uses; they are generally on the outside of the joints, and preserve the connection of the bones which are in motion, by their great strength and vigorous adhesions. In the Greek language, from which we have borrowed many of our terms, their name is *Syndesmoi*,* and as their functions, with the numerous diseases, and the many accidents to which they are exposed, have often attracted the attention of both the surgeon and physician, they have given rise to that branch of anatomy which is styled Syndesmology. In our descriptions, the particular ligaments are seldom enumerated; but reckoning classes sometimes as pairs, those which are described, and have gotten names, are about 100.

The connecting substances called Membranes, are in general thin webs, of a whitish colour, more flexible and elastic than ligaments. Besides assisting in the security and motion of the joints, they answer a variety of other purposes. They line all

* Συνδέσμοι.

the internal cavities, with a few exceptions; surround every organ of the body; and, while they contribute to unite the whole, they interpose and preserve a distinction, making separate parts either to co-operate, or to act as independent. They vary in strength, texture, and appearance, and have different names in different situations: Two, within the cranium, or head, are called Matres; some, which inclose bundles of flesh, are named Aponeuroses; that which lines the cavity of the chest, and surrounds its viscera, is named Pleura; that which surrounds the cavity of the belly or the abdomen, and furnishes a covering to its viscera, is Peritoneum; those which inclose articular surfaces, where motion is extensive, are termed Capsules; those which surround bones, are Periostea; and those which surround cartilages, Perichondria; when they surround any other organ, they are generally termed Tunicæ, or Coats.

The remaining substance which contributes to connect the bones, is flesh. The fore legs, or, as we speak in the language of anatomy, the superior extremities of many quadrupeds, adhere chiefly by this connection to the rest of the system. The flesh indeed adds to the security of all the joints,

although we shall find that its principal function is widely different, and that it performs a still more important office in the body.

As yet, we have only seen how the bones are joined by articulating surfaces, and how they are preserved in their situation by connecting substances. We have now to inquire by what causes they are put in motion. On a slight examination, we soon perceive, that the causes of all the motions of the body are bundles of flesh, which bundles, or fasciculi, anatomists, borrowing a term from the Greek, have denominated Muscles. Many of the muscles, besides flesh, contain a substance somewhat like ligament; and many, through the medium of this substance, adhere to the bones: this is the substance, that, in common language, is called Sinew, but in Anatomy is better known by the name of Tendon. Both are constituent parts of a muscle, the flesh and the tendon: both are equally composed of fibres obvious to the sight, and these fibres composed of others that are still smaller, and the smaller fibres composed of others smaller and smaller, so far as they can be traced by the microscope. But even the fibres, obvious to the sight, are never enumerated, nor indeed all the fasciculi or bundles which they compose. Of the fas-

ciculi which are regularly described, and have gotten names, reckoning classes sometimes as pairs, the number amounts to nearly 400.

The branch of Anatomy which treats of these organs, is styled Myology; and to those who are anxious to found their treatment of luxation and fracture on the principles of science, and not on the precedents of ignorant empiricism, it holds out the most flattering prospects of distinction and eminence, by removing one of the greatest opprobriums in the art of surgery; while to those who are struck with the singular phenomena of animal motion, and inspired with the true spirit of philosophy, are desirous to know by what kind of powers animals breathe, circulate their blood, and digest their aliment, or by what kind of mechanism, superior to human, they swim, walk, leap, and fly, in such an astonishing variety of ways, it is, without exception, the most instructive, and the most interesting part of the science.

As the muscles, however, are only the immediate organs of motion, we must still proceed in our inquiries, and try to discover from what source they derive their energy. On minute examination, we soon learn, that certain white filaments, or ropes, not only enter the different muscles, but

all the various organs of the body, and when traced to their origin, are regularly found to terminate in the brain, or in what is by some reckoned its production, the spinal marrow,—a substance contained in the cavity of the spine, and which, whether a production of the brain or not, is connected with the brain, continued from the brain, conjoined with it in function, and similar in appearance, substance, and texture.

The filaments, or ropes, issuing from these, are called Nerves, and are proved, by experiment and observation, to be the primary organs of sense, motion, and feeling. The nerves employed in all those functions that are absolutely necessary to the growth and preservation of the individual, perform their offices without our consciousness, while those distributed to the different organs by which we procure conveniencies and comforts, are subject to the will: at the same time both classes derive their energy from the vital power, but whether directly, or through the medium of some other substance, is a secret in Anatomy which neither the past nor present times have been able to disclose.

All nerves, of whatever description, are branched or ramified; but the numerous branches into which they separate, have never been counted, and in

many instances cannot be traced; the number described depends much on the taste and dexterity of the anatomist. The trunks themselves, issuing from the brain and the spinal marrow, reckoning them in pairs, are about 40, and in tracing both them and their branches, we observe them, in certain definite places, swelling into knots, which are called Ganglia, or forming networks, which are named Plexuses. The 40 pairs of trunks, with their pairs of branches, ganglia and plexuses, dignified with names, are above 100. The branch of anatomy which treats of these organs, is styled NEUROLOGY.

Having thus seen how the bones are articulated,—by what kind of substances they are connected,—by what organs they are put in motion,—and from what source their motion is derived, we have next to inquire, how they and the other organs enumerated, increase in bulk, advancing gradually from the period of conception, when the whole make scarcely a visible speck, to that size which they afterwards exhibit in maturer years. That a vital power, totally distinct from any that is known in chemistry or mechanics, constructs and arranges the different organs, and regulates, from the very dawn of our existence, all the processes of growth and nutrition,

must be obvious to every candid observer who takes but a transient view of the subject. Yet growth and nutrition necessarily pre-suppose a supply of nourishment: Whence then is this nourishment derived, and by what means is it conveyed to the several organs?

Upon examining the animal structure, we find, that the only possible and immediate source of this nourishment, must be the blood, which flows by a thousand various channels into all the different parts of the system. This blood, by rest, spontaneously separates into two parts, a solid and a fluid; the solid again, by a slight pressure, likewise into two; while chemical analysis has shown, that each contains a considerable variety of ingredients.

All have remarked the singular colour of this fluid. An English anatomist of the name of Lower, observed that it got a shade of this colour in the lungs, or in those organs by which we breathe; while Mayow, another English anatomist, endeavoured to prove that it is the air regularly inspired into these organs that give it this shade.* At any rate, experience has shown, that, without this regular supply

* In the incubated egg, the blood is red, before the heart or the lungs become visible.

of air, the blood could neither nourish the parts nor support life. Such then being the fact, and the heart the great fountain of the blood, we must necessarily suppose that it will send some to the lungs, in order to receive that supply of air which had been long and vaguely conjectured, but by Mayow demonstrated, if not to be the only, at least to be the principal support, and regulating cause of animal temperature. In man accordingly, and in every other animal with warm blood, we perceive no less than a double heart, or at least two cavities that are named ventricles, one for transmitting blood to the lungs to receive air, and the other for distributing it afterwards through the system, and even to the heart and the lungs themselves, for the purpose of nourishment.

The young anatomist will very naturally be anxious to know, what is the cause of the constant and impetuous flow of the blood. To meet his inquiries, it must be remembered that the heart is a muscle; that through the influence of its nervous energy, it is made to contract and relax, alternately, more than 60 times in a minute, and, at that rate, most singular to tell, without either pain or fatigue during the whole period of existence, be that protracted to 60, 70, 80, 90, or 100 years. When it relaxes, its two

cavities or ventricles are enlarged, and the blood flows in; when it contracts, the ventricles are diminished, and their blood propelled into two large pipes, the one leading directly to the lungs, and the other to all the rest of the system.

These two pipes are named Arteries, and as they likewise have a muscular power, and at the same time are very elastic, by contractions similar to those of the heart, they propel the blood towards their extremities, while a valvular apparatus, at their commencement, prevents it from returning by the same channels back to the heart.

For the more minute distribution of their blood, these two arteries are branched or ramified, while the branches proceeding from the same trunk are frequently observed to unite in their course, and obviously with this intention of nature, that when some are obstructed, the parts may be duly supplied by the others with which they communicate, or, as we speak in the language of Anatomy, with which they inosculate or anastomose, the number of branches into which the two arteries divide, is decidedly beyond all computation. It is only the larger and the least numerous that are traced by the eye, even when assisted by a powerful microscope, and of these, only the more regular are dignified

with names, amounting in pairs to more than a hundred.

As the blood, however, on account of the valves, cannot return by these arteries back to the heart, we must necessarily look for some other channels by which it is again conveyed to the fountain. Now, by numerous experiments and observations, Harvey, an Englishman whose name should be dear to every anatomist, discovered that those branches of arteries which were large enough to convey red blood, transmitted it to branches that conveyed it back in an opposite direction, and that these last branches, by reiterated unions, formed large trunks, which returned the whole from all the parts to which the branches of the arteries had sent it.

He also observed, that the whole of the blood was sent through the left ventricle of the heart to the system at large; that the whole was returned by the retrograde vessels back to the right; that the right transmitted the whole to the lungs through the pulmonary artery; that there it was received by retrograde vessels that conveyed it again to the left ventricle; and that the left conveyed it again to the aörta, or the pipe that distributes it through all the various parts of the system. This is the regular course of the blood, which is called circula-

tion, and which has conferred so immortal an honour upon the discoverer—a man as much distinguished by his modesty, as by the superior excellency of his genius.

While the blood in the arteries regularly flows from trunks to branches, in the retrograde vessels, with only one exception, it as regularly flows from branches to trunks. These retrograde vessels are distinguished in anatomy by the name of Veins; they are still more numerous than the arteries; are usually found lying by their sides; are described by nearly similar names; have a much less muscular power; and as they are not assisted by the heart in propelling the blood, as happens to be the case with the arteries, they open to it larger and larger channels as it advances, and have valves at different parts of their course to prevent its reflux.

But here the young anatomist will say, that this is no explanation at all of what we proposed; for, if the arteries transmit the whole of their blood to the veins, and the veins return it back to the heart, how are the different organs to be nourished? The observation is certainly just; and, in order to account for the nourishment of the system, we must necessarily suppose, that certainly some branches of arteries wander from the course of this circulation, and terminate otherwise than in venous branches.

The truth is, we find that various series of branches belong to the arteries; that those composing the ultimate series are so minute as not to admit the red and grosser parts of the blood; that many are destined to convey only the thinner portion of this circulating fluid; and that many of these, wandering from the circle, empty themselves into bones, muscles, ligaments, and nerves, and the other parts of which the animal fabric is composed; when there, each part, by a vital process that is called Assimilation, converts this fluid into a substance of its own specific character and properties.

We observe farther, that some of this last series of arteries open on the surface, where they exhale perspirable matter; others on the central aspect of the lungs, exhaling that vapour which appears in the breath; that others again, for various purposes, pour out their fluids into the different cavities of the system, and many into bodies of various shapes, sizes, and structures, which anatomists have chosen to call Glands, and in which the fluids of these vessels are, by certain processes, changed into fluids of a different quality; some of these, to lubricate the joints and the parts in motion; some to assist in preparing the aliment and promoting digestion; some to protect the skin and the surface; some a fluid, employed as a means to generate the species; and

some a fluid to nourish the offspring after its birth.

But though we have thus nourished the system, by allowing the fluids to escape from the course of the circulation, it may naturally be asked, What have we gained by the explanation? The difficulty is rather increased than diminished; for, having allowed the fluids to escape, to be lodged in bones, ligaments, muscles, and shut cavities, how are we to return them? How dispose of them? And by what means, when the body is wasting, shall we carry off the decayed parts? As these fluids do not accumulate in the healthy state, there must be necessarily some way by which they get out, or some other system of vessels besides veins by which they return to the mass of blood.

For the solution of these difficulties, we are chiefly indebted to Rudbeck, a Swede, Bartholine, a Dane, and Jolyffe, an Englishman, who discovered, nearly at the same time, a system of vessels that conveyed all the decayed parts, and all the thin and pellucid fluids that were carried by the smaller series of arteries from the course of circulation, back to the blood.

From the clear and watery appearance of the fluid which they contained, they were named Lym-

phatics: they arise from all the internal cavities, commence towards every part of the surface, and have origins in every organ of the body. In short, they accompany the smaller arteries in the same way as the red veins accompany the larger. They are therefore a subordinate system of veins, destined to return the thin and pellucid portion of the blood which flowed in the smaller series of arteries; which arteries might be named the Lymphatic Arteries, and these with propriety the Lymphatic Veins. As the smaller arteries are more numerous than those which carry red-coloured blood, the lymphatics are more numerous than the red veins,—are, like these veins, furnished with valves, and, like these veins, carrying their fluids from branches to trunks, they at last terminate in two trunks, which discharge their fluids into the trunks of the red veins a little before they enter the right auricle of the heart.

Having thus brought the lymphatic fluid, and all the decayed parts of the system, back to the blood, we must now consider in what way we are to dispose of them. It is very evident that these fluids are sent back for one or other of the following purposes, either to undergo new preparations to fit them again for those situations which they formerly occu-

pied, or to be thrown by some emunctories out of the system. If they return to undergo new preparations, and remain in the system, for what purpose are the regular and constant supplies of nourishment? For, if the supplies of aliment be necessary, it will be difficult to assign a reason why the decayed parts of the system should be retained. But the supplies of aliment are necessary, and therefore it follows that the decayed parts of the system should be thrown out. The conclusion, however, necessarily involves us in new embarrassments: For by what channels are we to discharge them?

To do this, we must have recourse to those small arterial vessels that wander from the course of the circulation, that was known to Harvey. Many of these, as mentioned already, open externally upon the skin, and upon the internal surface of the lungs; others terminate in two large glands, which are called Kidneys, and in which the urinary fluid is secreted; many also discharge their contents into that long, winding canal, which begins at the mouth, and terminates at the opposite extremity of the body. By these outlets we are able to demonstrate how, along with the vapour from the lungs, the perspirable matter from the skin, the fecal discharge, and the urine, all the decayed parts are evacuated.

Having thus seen how these decayed parts are removed, and how the system is nourished by the blood, we have next to inquire, how the blood can sustain this loss, and by what channels its supplies are conveyed into the course of circulation.

We see the food taken into the mouth, we see it masticated by the teeth, and plentifully mixed with that juice which is called Saliva, and which flows into the mouth from a number of glands in the vicinity. As it moves along, it receives more juice from vessels and other glands in the passage; it arrives soon at a large dilatation of this canal, which is called Stomach; here it meets with another juice that is named the Gastric: the canal again becomes narrow, and is named Intestine, with many convolutions, and nearly six times the length of the body. Into this portion of the canal glands and vessels likewise continue to pour in their fluids, to lubricate the tube, or assist in the preparation of aliment. Two of these fluids are distinguished by their quantity, by the size of the glands in which they are prepared, and the largeness of the ducts by which they are conveyed. The first of the two—of a greenish colour and a bitter taste, is named Bile, and secreted in the liver; the second is called the Pancreatic Juice, secreted in a gland that is named the Pancreas.

By the assistance of all these juices, by the heat of the body, and by the action of the canal, which possesses a degree of muscular power, all the nutritious part of the aliment is converted into a white and thin fluid, in colour similar to milk, which is termed Chyme. If we could shew how this chyme gets into the blood, we should solve the problem, how the blood receives its regular supplies, and from what source the system is nourished. The ancients thought that the chyme entered by the red veins that spread upon the intestinal tube. Their opinion, however, was hasty and erroneous. The truth, here, was a secret in Anatomy for many ages, until Asellius, an Italian anatomist,* chancing to open a live dog, discovered, by accident, a number of vessels, different from the veins, opening into the tube, and absorbing the chyme, which, on entering these vessels, assumed the name of Chyle. These vessels, from their milky-coloured fluid, were called Lacteals, and were afterwards traced uniting together, entering the trunk of the lymphatics, and sending their fluid into those veins which open through the medium of its auricle, into the right ventricle of the heart.

* Erasistratus also had seen these vessels, but knew not their functions.

Having thus taken a general view of all the various classes of organs in the human body, and their different functions; having seen, in general, how the bones are united by articulations; how connected by ligaments, membranes, and flesh; how put in motion by the action of muscles, and how these derive their energy from the nerves: having likewise seen how every organ is nourished by the blood; having seen how this fluid is sent from the heart, by means of the arteries, and conveyed back through the veins and lymphatics; having seen how the useless or decayed parts are evacuated, and how the nutritious part of the food gets into the course of the circulation,—we have now to inquire, by what means can this complex and delicate machine be preserved in existence for such a great number of years?

To meet this inquiry, the system is guarded from external injuries by its integuments; the first of which, a thin covering, without any feeling, called Epidermis; the next a glairy mucous substance, known by the name of the *rete mucosum*, beneath which are two thin cuticles, and beneath these the *cutis vera*, or the true skin; beneath all is the *Tela cellulosa*, or cellular membrane, which proceeds inwards, penetrates most of the organs of the body,

and seemingly contains the whole in its cells. But though the animal owes much of its general security to these coverings, it owes more to these senses, instincts, and appetites, which the wise Author of Nature has bestowed. By these, it is led to pursue what is useful, and to guard against danger, inconvenience, and want. Nor is this all: he has likewise conferred, to a certain extent, on all living bodies, the power of reproduction, by which they are frequently able to repair the slighter injuries to which the different organs are exposed; and if this power be exceedingly languid in the latter periods of old age, it is because the Author of Nature never intended that the animal structure should be immortal. He has fixed its bounds, which it cannot pass, and has measured out the time when the fairest fabric must crumble into dust, and its animating spirit return unto Him, the great Almighty Incomprehensible Being, who at first bestowed it.

LECTURE SECOND.

HAVING taken a distant view of the system, I shall now make a nearer approach, and point out the mode by which we may attain a more accurate inspection. In the Anatomical part of the Course, I intend to demonstrate the several organs, as nearly in the order in which they have been mentioned, as the nature of the subject will conveniently permit; at the same time I shall study to explain their different functions, so far as they are known to modern physiologists; and any observations of that kind that cannot with propriety be introduced with the demonstration, shall be reserved for separate lectures.

When the parts are before us,—to arrest the attention, and to make a more lasting impression on the mind, I shall sometimes mention the time of their discovery, their successive improvements, with the accidents and other circumstances that led to them.

For the sake of illustration, and of those gentlemen who may wish to acquire more extensive ideas of the animal economy, or even of living bodies in general, I shall occasionally introduce Comparative Anatomy, and, where the analogy seems to be striking, point out the structure and functions of plants. But, in order to prevent confusion and error, I shall at all times keep in my view the human body, as the standard or scale by which the size, form, situation, and proportions are to be estimated. By a steady adherence to this plan, it is to be hoped that our principal object will be better illustrated and understood, our ideas accumulate without confusion, and become general without being vague.

In many respects this comparison is necessary. All living bodies with which we are acquainted, are constructed on one general plan, possess similar, at least analogous, organs and functions; and being modified only as to class, order, genus, and species, contribute much to illustrate one another. In one animal, for instance, the organ is small, its structure complicated, or its use obscure; while, in another, this organ is large, its structure simple, and its use obvious. So that many discoveries which are now made in human anatomy, would have still been unknown, had they not been previously made in the comparative.

Another reason for appealing to the structure of various animals, is, that by confining our researches to one species, we might be apt to ascribe too much to the form, size, structure, and situation of organs, but, by examining different animals, we soon learn that similar functions may be performed by organs of various forms, magnitudes, proportions, situations, and structures, or should the functions happen to be varied according to the organs, we are led to a very useful inquiry, not only how far the variety of function, but of genius, habits, instincts, and manners, is connected with each variation of the organs.

Thirdly, Without the aid of Comparative Anatomy, we might often be induced to entertain false conceptions of the relative importance of the different organs; but when we see them imperfect in one animal, wanting in another, diseased, obliterated, or extracted, in a third, with or without any essential injury to life, we have then criteria by which we may be able to form some judgment of that rank which they hold even in the human species.

Fourthly, Comparative Anatomy becomes necessary in ascertaining the action of organs. All the functions have long ceased before the human body can legally be opened; and it is only in the lower animals that we can presume

to make experiments, and examine the mechanism while it is in motion. It is, therefore, in this field of inquiry that we chiefly have acquired our knowledge of the functions.

Lastly, Comparative Anatomy is an object of importance; considered by itself, it can be practised at all times, and in all places, with very little inconvenience or obstruction. By it a person may readily acquire a facility in dissection, a dexterity and confidence in surgical operations, and not only preserve, but extend the knowledge which he has acquired of the human system. Above all, it is found of singular utility in natural history; it there lays open an extensive field of useful inquiry, and, every day, becomes a source of, not only delightful, but endless amusement: it not only shews us how to examine the structures of animals with our own hands, but if we be fond of works on Zoology, it comes forward like a friendly interpreter, explains a great number of phenomena which otherwise we could not possibly comprehend; presents before us a wide range of animated beings, infinitely varied in form, magnitude, and colour, in strength, instincts, habits, and manners, yet all exhibiting a number of the same common functions, and all proving that our generic and specific distinctions are only branches of the same

plan; that all are radically and essentially the same; and that we ought to study the whole, if we wish to have just or enlarged ideas of the animal economy, or be much interested in the improvement of that science which is styled Physiology.

In the sense of anatomists, physiology is the science that treats of the functions of the different organs, whether separate or combined. You will readily perceive that this science must be intimately connected with a course of anatomy: they are indeed so intimately connected, that, in the opinion of the late Dr Hunter, they should never be separated. "The man," says he, "who makes it his "business to investigate every thing relating to the "structure of the human body, must be, *cæteris pa-* "*ribus*, the fittest person to explain its operations, "and there cannot be a more proper occasion than "when the parts are before him." In that case, the uses and functions will be regularly demonstrated, and not merely talked of, as they are in books and in courses of physiological lectures,—a practice which Hunter had strongly reprobated, and which, from seeing its pernicious tendency, had made him determine to incorporate physiology with his anatomy, the only way in which it could be taught with accuracy or advantage. I am so far of these senti-

ments, that I really think a course of anatomy without physiology, or a course of physiology without anatomy, would be scarcely an object deserving your attention: for, what does mere anatomical dissection present to the student, but a set of facts without explanations; and what does mere physiology present, but a suit of observations, hypotheses, and hearsays, ultimately founded, as is always pretended, on the evidence of facts, but these facts never brought forward into your presence, either to confute or corroborate the assertions. If you hear their evidence, you must hear it through the medium of an interpreter, and are no more likely to discover the truth than you would be from hearing one side of a pleading in a court of law. Nay, after both sides have been heard, it has frequently happened, that the truth has remained in as great obscurity as before. Many of the facts on which the great discovery of the circulation was founded, were known previous to the time of Harvey; but their evidence was taken upon the report of those physiologists who had humours, interests, and hypotheses to serve. Harvey was the first who had the courage, perseverance, and candour to collect them together, to bring them forward, and then to make them, in presence of anatomy, to deliver their evidence without an in-

terpreter. The circulation was thus made known, for the first time; and, though some physiologists endeavoured to obscure it by their false glosses and interpretations, yet anatomy as regularly brought forward the facts to speak for themselves, and at last succeeded in establishing the truth beyond the possibility of contradiction.

In the following course, I shall, therefore, with Hunter, consider anatomy and physiology to be as they ought to be, inseparably connected, and combined together as closely as they are in the great elementary work of Haller. In this view, anatomy will not only furnish us with the facts, but with the explanations, so far as they are warranted by ocular demonstration, while, at the same time, it will guard us against being duped by hypotheses that rest upon the evidence of oral testimony, which exhibits facts through a false medium, and which have so often disgraced the pages of physiology. In this sense, I may safely venture to say of anatomy, that it is not only ornamental and useful, but even indispensable to the surgeon and physician, who, as guardians of health, can never be qualified, either to preserve, improve, or restore it, as long as they are strangers to the nature of the organs, or the state of the functions on which it depends.

By way of contrast to the skilful practitioner, who has made all the necessary preparations for entering on the duties of his profession, let us fancy a man ignorant of anatomy, and yet presuming to practise without it, by what means can he ascertain the seats of disease, discover the particular organs affected, estimate the danger of the complaint, or foretel its issue? Having never seen the parts, or viewed them but carelessly, he must be a stranger to their connection, their situation, and relative importance; and, though custom and fashion may sometimes lead, as well as mislead him, yet when anomalous symptoms appear, he must be involved in inextricable difficulties: it will then be in vain to look for precedents in past experience; his only guide must be ignorant conjecture, which, directed by timidity, will lead to a practice feeble and inert, or, directed by rashness, to one that is equally dangerous to his patient.

Suppose that his patient shall at last sink under the distemper, and that our practitioner is required by the friends to open the body, to ascertain the seat of the disease, the extent of the injury, and explain the connection between it and its symptoms, in what manner is he to proceed? Is he frankly to acknowledge his presumption and ignorance, or tacitly betray them by his awkward confusion in opening the

body? Or, granting that no confession is made, and that no signs of confusion appear; on opening the body, what does he see? The viscera lying together in a mass, which he knows not how to dissect or demonstrate; various colours, sizes, and forms, but no one to tell him whether these be the natural or diseased appearances. He must feel like a stranger in a foreign country; he has a list of the different places which he means to visit, but cannot distinguish the one from the other, until they are pointed out and described; he is ignorant of its history, its manners, and its language; he has no guide, no interpreter, no map of the roads to instruct him; and, bating a little folly and conceit, returns as ignorant as when he went abroad. But, let him pretend to have discovered what he was seeking, another comes after him, examines a case that had been attended with similar symptoms, and detects not only the ignorance and falsehood of his report, but exposes him to public ignominy and contempt.

Let us next bring him, in the character of a surgeon, to a patient who is labouring under a severe local affection. The disease, he is told, is extending rapidly, and the question is asked, Will an operation prevent the consequences; are the parts contiguous of much importance; how far is each, or how

far are the whole, essential to life; may an operation be performed with freedom; or will it require an uncommon dexterity, skill in anatomy, and circumspection; or, are the circumstances of the case such that no operation can be performed, or that no operation can be of service? To be placed in official situations of this kind, to have these, or such questions proposed, and yet to be totally unprepared for an answer, must be highly distressing to a person of any sensibility or spirit, and who, than be reduced to such a dilemma, would not rather undergo a thousand inconveniencies in obtaining that necessary degree of information which both his honour and the duty of his profession point out to him. But should an operation be found necessary, a new train of embarrassments must ensue: Information alone will not be sufficient; that dexterity of hand, which can only be acquired by practice in dissection, and that firmness of mind, and quickness at expedients, resulting from the habit of being familiar with such scenes, are qualifications equally indispensable.

Yet, uneligible as his situation may be, his patient is still more to be pitied. Let us figure to ourselves but the circumstances of his case, when the knife of such an unskilful operator is making

its incisions, and, surrounded with blood, is moving at random in the widening gash, and at every stroke making a number of hair-breadth escapes amidst a variety of important viscera on which life depends.

It is surely for the quiet of our own minds; it is for our interest, and for our reputation, that this information and these habits should be acquired: for, can we imagine that any person, not totally deaf to the dictates of humanity, and callous to every true sense of honour, could, after mature and deliberate reflection, enter on a charge where he is entrusted with the lives and happiness of his fellow-creatures, provided he were conscious of his own inability, and fully persuaded that, not only individuals, but whole families, might suffer irrecoverably through his incapacity or criminal neglect in point of education.

"When we hear any man of the profession," says Dr. Hunter, "talking of all the knowledge of anatomy that is necessary for a physician, and of as much as a surgeon needs to know, we cannot but lament the singularly hard fortune of his patients, first, in being sick or diseased, and then in falling under the care of so ignorant a counsellor. Who is the man of practice and integrity, that can lay his hand on his heart, and say, that he has not, some

time or another, had occasion for all his anatomical knowledge, and who has not wished, at times, that he had been possessed of more?"

I know it has been said that many a practitioner has met with considerable success in practice, without much knowledge of either anatomy or physiology. I doubt much the truth of the assertion, and more particularly, as the reputation of great success and of great skill may sometimes be acquired by bold pretensions and by artful imposture, where skill and success were nowise concerned. But, granting it was true, many a blind man, by groping his way, has travelled through a country, and through the narrow alleys of a town, without suffering any disaster; yet will any one assert, that he could not have travelled with more ease, expedition, and safety, had he enjoyed the advantages of sight.

Now, in some measure, anatomy is to medicine what sight is to the body; and we have not much hesitation in saying, that those who venture to practise without it, must not unfrequently be groping in the dark. We must feel, therefore, a kind of regret, that the father of physic, from the times in which he lived, was unavoidably ignorant of many of the organs of the animal structure, knew nothing precisely with regard to the functions of those he

had seen, and was often led to explain the general economy of the system, upon the principles of a philosophy which nature has disclaimed. A feeling, however, of a different description arises in the mind, when we see ignorance swollen with conceit, and proudly neglecting not only the frequent but inviting opportunities of acquiring information. We can hardly read, without feeling a decree of contempt for a celebrated modern treatise upon farriery, where much is said of the cure and diseases of the gall-bladder in horses; though no horse, if we can trust to repeated dissections, ever had a gall-bladder.

I might easily collect numerous instances of the like kind, arising from the neglect of anatomy. But I hope it is obvious, that a medical practice, thus founded upon ignorance, and upon the hypotheses of organs and functions, and imaginary agents, cannot fail to be hurtful, and that it is the interest of every one engaged in the profession, who has a regard for his own character, or the good of others, to acquire as complete a knowledge of the structure and of the economy of the human body as his own ability, or the present state of science, will permit.

The question is, By what means is this information to be acquired?

In my opinion, by that patient and accurate dissection which displays the structure.

By calling to our aid the mechanical philosophy which illustrates the general properties of matter.

By applying likewise to the chemical philosophy for an explanation of these properties that belong to certain combinations of matter: And

By diligent inquiry into the cause or causes of those phenomena that characterise living organized systems of matter.

From these sources has the whole of our present information been derived; and I now shall proceed, as a general, and, I think, as an useful preparation for that course on which we are to enter, to mention some of the principal discoveries which each of them has furnished, and to point out, at the same time, those particular departments in which each, under a prudent management, may be made instrumental in leading to improvement and to future discoveries.

Observing the order in which they have been mentioned, I shall begin with a general account of the principal discoveries made by dissection. It were to be wished that the history of this part of anatomy were better understood. Ignorance here has not only retarded the progress of the science, but, unfortunately, combined with selfishness and

vanity, has threatened its decline. Haller, the most enlightened judge of his age, observes, that anatomy was better understood 40 years before his time, than at the period when he wrote.* His contemporaries then, like many of ours, were so much occupied in describing, and wondering at what they themselves had both seen and done, that they either did not know, or cared not about knowing, that the like had repeatedly been seen and done by others before them. It, therefore, happens, that many discoveries of the present day, are the mere repetitions of what have been made centuries ago: that many of our present theories and hypotheses, considered as quite original and new, are in fact very old, and are now only returning to visit us, after a long period of absence, though generally, indeed, under new names, and somewhat disguised in their language and manner.† Our modern anatomists, not usually remarkable for

* En général, dit M. de Haller, on a des connoissances moins entendues sur l'anatomie de l'homme, qu'on n'en avoit il y a quarante ans. *Preface, p. 3. à l'Histoire de l'Anatomie et de la Chirurgie, par M. Portal.*—I have quoted Portal, as I have not yet found the passage in Haller to which he refers.

† The rational, animal, and vegetative souls of Plato, appeared on the stage in the days of Galen, under the names of the Animal, Vital, and Natural Spirits, lately characterised by Bichat under the name of Animal and Organic Life.

their erudition, excepting what they gather from indexes, from the foolish supposition, that our whole stock of knowledge is contained in the common-place treatises of the schools, imagine themselves to be first-rate discoverers, when they notice a fact, or make an observation, that is not found there. To prevent anticipation, they hurry to the press, pregnant with their new and important materials; tell us how little they have learned from books, and how little others may expect to gain from them; that all before them have been wandering in the mists of ignorance or error, and that they alone are the only persons who have been able to develope the mysteries which nature had so long tried to conceal. This sort of language is admirably suited to the young and inexperienced, who are fond of novelties, and who are generally disposed to believe, that the last book published contains the whole information on the subject. The works of the ancients, and our learned predecessors, are therefore neglected for the meagre productions of these selfish and illiterate pretenders; and this practice, of which Haller and Portal so grievously complain,* is likely to conti-

* See Portal's Preface to his History of Anatomy and Surgery, and Haller's Prefaces to different volumes of his Elements of Physiology.

nue, and even to increase, as long as weak and ignorant credulity shall incline to give credit to their assertions.

But, as all the moderns are not included in this general censure, to do equal justice to them and the ancients, let us candidly trace the progress of the art. Dissection, as an art, was certainly unknown to the rude and more early periods of society. All that was then known of the structure, was collected chiefly from casual observations. There were few who had not opportunities of seeing the bones of inferior animals at the feast; many had seen even human bones on the scenes of battle, dug out of graves, or washed down from the banks of rivers.

Among the great number of men, and of lower animals that perish in the fields from disease, hunger, fatigue, or violence, whole skeletons would be sometimes observed.

The huntsman, the priest, and those who killed animals for food, would be frequent witnesses of the form, situation, and colour of the soft parts: the haruspex, or augur, was often obliged to examine them with attention, and, in many instances, was able to distinguish the natural and preternatural appearances; while the priest, whose deity chose to be honoured with human sacrifices, could not fail to re-

mark the striking analogy between man and quadrupeds.

But, to say no more, their language is a proof, that, though ignorant of their intimate structure and functions, they at least had names for the principal bones, and the most important and conspicuous viscera in the human body; and we are assured, that, from attending to fractures and wounds, the progress of disease, and the methods of cure, they had even acquired some knowledge of the animal economy. Yet, after all, their knowledge was imperfect: "Anatomy was not practised as an art; "they seldom reasoned upon what they had seen; "their observations were not turned into use; they "were not made to reflect light on medicine, or to "direct the operations of surgery."

Some, indeed, are inclined to believe, that the ancient Egyptians had as accurate and extensive a knowledge of anatomy as we have at present. They say that Athotis, one of the first sovereigns of Egypt, was the author of several books on the subject, in which he laid down rules for dissection: that one of the medical treatises of Hermes related to the structure of the human body: and, lastly, that much of this knowledge was implied in the art of embalming.

The claim of Athotis is supported by Eusebius and Africanus, as quoted by Syncellus, and their authority was the popular tradition of Egyptian priests, who, to raise their country in the estimation of the credulous Greeks, pretended to all that was learned and scientific.

Hermes is known to have been the tutelary spirit of the pillars on which the writings of Egypt were inscribed, and was therefore considered not only as the patron, but the inventor of their arts and sciences. But, as Hermes in Greece, Mercury at Rome, and Thoth in Egypt, signified a pillar as well as a god, the writings of Hermes had a twofold meaning: they might either denote, simply, the writings inscribed on the pillars, or the writings of the god to whom these pillars were consecrated. The last was the sense in which the priests were anxious that the phrase should be understood: for, among the ancients, it was a more common species of fraud, to publish their writings under celebrated names, than, like the moderns, to pilfer the writings that belong to another, and impudently to publish them as if they were their own.

By the writings of Hermes, we are then to understand the writings of the priests: and, indeed, we are told by Jamblichus and Galen,† that every new

† De Mysteriis Egyptiorum. Also Galen, Lib. I. contra Jul. de Simp. Med. Fact, Lib. IV. See Bergman's Hist. of Chemistry, p. 44.

discovery in Egypt was first approved by the common voice of the priesthood, and afterwards engraved upon these pillars or stones of the temple, without the author's name. Hence these writings, from cunning on one hand, and from ignorance, credulity, and superstition, on the other, being generally supposed the writings of a deity, were thought perfect. It was deemed sacrilege to attempt any improvement or change; and the learning of Egypt accordingly, like that of China, became stationary for ages. If a patient died, the surgeon or physician who attended, was examined, and if it appeared that, in any respect, they had deviated from the practice recommended by Hermes, they were punished with death.

These facts contribute little to exalt our opinion of either Egyptian anatomy or physic. It has been suggested, that many improvements must necessarily have arisen, from a custom in Egypt, which permitted none to undertake the cure of the whole system, but required each practitioner to confine himself to some particular organ or function. The inference here would certainly be just, if they had possessed a general knowledge of the whole system, and of the mutual dependance of its several organs, or, if this custom of theirs had arisen from the same

motives as our modern division of labour. But a passage of Origen would seem to insinuate, that their practice rather proceeded from the gross superstition of judicial astrology. The Egyptians had divided the human body into thirty-six parts; each of these parts had its tutelary genius; their diseases were owing either to his displeasure or neglect, and, in most cases, were to be removed, not by physical skill, or physical remedies, but by certain magical incantations and rites.

As for embalming, that art, as described by Herodotus and Diodorus Siculus, required no skill in anatomy: it was merely the consequence of a certain creed, and was rather a ceremony of religion, than a lesson in anatomy. The brain was extracted through the nostrils, the intestines through a small incision in the belly.* The instrument used in this last operation was a stone; and, as the Egyptians regarded with horror any person who offered violence to a dead body, the one who made the incision, fled immediately, as if he had incurred the public malediction, and those who were present pursued him

* Herodotus, in Euterpe, describes different modes of embalming; and in the Notes to Beloe's translation, the reader is referred to these works, where all the information respecting the art of embalming by the ancients is to be found.

with stones, as a mark of national detestation and abhorrence.

These accounts, again, ill coincide with Egypt's high pretensions to Anatomy. It is in vain to appeal to her mummies: many of these are preserved in our museums, but exhibit few marks of dexterity or skill in the operator. Our modern collections of birds, quadrupeds, fishes, and insects, display infinitely more ingenuity; and yet these, we know, can be easily prepared without any anatomical acquirements.

If we wish to see the commencement of Anatomy, on a rational plan, made the study of ingenious and learned men, and directed with a view to surgery, physic, and philosophy, in general, we must look to the Greeks. That singular people, intrinsically ennobled by their greatness of mind, and their spirit of enterprise, were the first who conceived the ambitious design of collecting the wisdom of all nations, of travelling into distant and foreign countries, and of returning, not enriched with their gold, their silver, or their commerce, but with a knowledge of their arts and sciences. They were the first, or among the first, who erected libraries; the first who attended to arrangement of thought; to simplicity, elegance, and correctness of expression—and who, thus qualified, established seminaries with

the generous intention of diffusing knowledge to all indiscriminately.

One of their travellers, and their earliest writer that is now extant, was Homer, their celebrated poet. He seems to have known the value of anatomy in surgical operations,—describes minutely the means employed in the cure of wounds,—the methods of extracting arrows and darts,—of stopping hemorrhages, and applying dressings,—dwells long on the luxations and fractures of the leg, and is quoted by Galen with respect to some of the abdominal viscera. He has even been thought to have wounded his heroes, chiefly with a view to show his acquaintance with the animal structure, and with the relative situation of its organs. * Some have admired his anatomy so much, that they have written books upon the subject; and though one may rather be disposed to smile at their absurd and extravagant encomiums, yet, it must be confessed, that his descriptions, so far as they go, are wonderfully accurate, and bespeak a degree of information that appears extraordinary for one at the period in which he lived. At any rate, his Iliad and Odyssey, so generally read and enthusiastically admired, must

* See Portal's History of Anatomy and Surgery, vol. i. p. 18.

greatly have contributed to raise an esteem for these kinds of subjects, not only in Greece, but in lesser Asia, in Sicily, and in Italy, and every place where his countrymen had settlements. In what manner he acquired his information, whether from actual observation and dissection, or merely from reading and conversation, is not known. At the period when he composed the Odyssey, and where he speaks of the blind Tiresias, he intimates distinctly, and with some feeling, that he, at the time, also was blind.

Pythagoras, the philosopher, seems likewise to have directed the attention of mankind to this study. Alcmeon, one of his pupils, is said to have dissected, with his own hands, and to have discovered certain passages which we find between the ear and the mouth. Empedocles, another, was the first who asserted, that all living bodies sprung originally from eggs; a proof that he had examined and compared the ova of animals and the seeds of plants. A third of this school is particularly mentioned as having employed much of his time in the practice of dissection. This person was Democritus of Abdera, a Greek, a traveller, a man of profound and extensive research,—a contemporary, and even friend of Hippocrates,—the inventor of the Corpuscular Philosophy, the Restorer of the Vacuum, proscribed

by Thales, and the first in history who applied his observations with a view to illustrate the animal economy. His peculiar manners, the place of his retirement, and the unusual nature of his studies, were thought, by his countrymen, the effects of madness. They therefore sent for Hippocrates to visit him. Hippocrates went, and found the philosopher sitting on a stone, under the spreading shade of a plane tree, a number of books arranged on each side, one on his knee, a pencil in his hand, and a number of animals, which he had dissected, lying around him; his complexion was pale, his person thin, his countenance thoughtful; at times he laughed, at times shook his head, mused for a while, and then wrote, then rose up and inspected the animals, sat down and wrote again: the subject on which he was writing was madness, and the object of his dissections the seat and nature of the bile, which somehow or other he conceived to be the cause of that distemper.

Hippocrates acknowledged the great importance of his inquiries, and regretted much that his own professional employments, his domestic concerns, and other avocations, did not permit him to indulge likewise in similar pursuits. From this confession, it may be supposed that Hippocrates,

prior to this period, had not devoted much of his time to practical anatomy, although the knowledge which he afterwards acquired, from observation, reading, or dissection, was not inconsiderable.

He has given a summary view of the bones,* and though not accurate as to their number, he has well described many of their forms, articulations, and processes,† and speaks of a fluid secreted in the joints to facilitate their motion.‡ He also frequently mentions the ligaments by which they are connected.

He even was not ignorant of the divisions of the fleshy part into those bundles which are called muscles. He has mentioned the spinal and the lumbar muscles.§ He has given names to two that are inserted in the lower jaw.‖ He has also mentioned the pulsations of the heart, and expressly calls it a strong muscle.¶ Had he said no more, one would be almost inclined to believe that he knew the functions of these organs, but in other places he

* Περὶ ὀστέων φύσιος.

† Περὶ τόπων τῶν κατὰ ἄνθρωπον.

‡ Περὶ τόπων τῶν κατὰ ἄνθρωπον. Ch. 14.

§ Περὶ ὀστέων. Cap. ii. Aphoris. 36.

‖ Περὶ ἀρθρων. Cap. xxxiv.

¶ Περὶ καρδίας. Cap. ii.

assigns the offices, which peculiarly belong to them, to the Neura, a term under which he includes not only tendons and ligaments, but even nerves,* arteries, and veins.

Although he has mentioned two nerves arising from the brain, and points out many† which seem to come from the spinal marrow, with which he was acquainted, I cannot observe, in his whole works, a single expression that amounts to a proof of his being, in the least, acquainted with their use. This circumstance is the more extraordinary, as he makes the brain the seat of the soul, and calls it the organ by which we see, hear, feel, and reason.

If the treatise in his works, entitled Περὶ Καρδίας, be genuine, which Galen denies, he seems to have examined the heart and its appendages with more attention; he notices parts which many have thought to have been the discoveries of later times, and often mentions the course of the bloodvessels in such a manner, that some have ascribed to him the most illustrious discovery in Anatomy,—the circulation of

* Περὶ φλεβῶν. Cap. xvii.

† Ibid. cap. vii. De Alimento, cap. v. *v.* 4. Medulla Spinalis, a production of the brain. Περὶ ἀρχῶν, cap. v. improperly named Marrow.

the blood. He indeed has spoken of a circle of the blood, περιοχη or a περιοδος διαφανης, and has mentioned a difficulty about fixing the place where he should begin in describing these vessels, as they form a circle without beginning and without end; but he who dreams of seeing a discovery in this language, must not only be very ignorant of anatomy, but little acquainted with the writings of Hippocrates. In the vascular plexuses, or networks of bloodvessels, I shall show you afterwards to what he alluded in these expressions, and that he had not even the most distant idea of the circulation that was known to Harvey. So far from it, he thought that the arteries contained air, and had his doubts whether the veins commenced in the liver, the heart, or the brain.

He was equally ignorant of the functions of the lungs. He imagined that animal temperature was owing to an εμφυτον πυρ,* or a native fire residing in the left ventricle of the heart, and that breathing was necessary for the regular admission of fresh air to support the combustion, to carry off the fuliginous vapours that otherwise would have checked it, and thus at once contributed to heat and to cool the

* Περι καρδιας, cap. v.

system. According to him, this air was applied by the two appendages belonging to the heart, which we, in compliance with his language, still call auricles, but to which he assigned the office of bellows.*

The ideas of digestion were not more correct: he believed that the stomach was a mere reservoir; that the food was prepared by putrescence or concoction; and was ignorant of the channels by which it is afterwards conveyed through the system. He knew, however, the seat of the bile, the secretion of the urine in the kidneys, and the two ducts by which he imagined that at least a part of it was conveyed into the bladder. I shall leave his doctrine of the four humours and four temperaments till we come to Galen.

With respect to his anima, or vital principle, it appears to be the same with the εμφυτον πνευμα † or the native fire, and is placed in the left cavity of the heart. In all cases, even in thinking, it acts from necessity, and conducts the whole business of the system by subordinate agents, which are called δυναμεις, faculties or powers. These *dynamies* are parts of itself, and reside in the different organs of the

* Περι καρδιας, cap. i. and iii. *v.* 5. cap. iv. *v.* 19. cap. vi.
† Ibid. cap. viii. *v.* 9.

body, performing the functions of seeing, hearing, tasting, touching, smelling, and the like.* But as these dynamies are parts of the *anima*, so the anima itself is only a part of, and subject to the power of *Physis*, or nature. This Physis is ethereal fire, immortal, intelligent, and just: it sees and it hears, it knows what is present, and what is to come; it sufficeth for all things, and invariably perceiveth what is necessary, and when, without being taught.†

Such is the anatomy and physiology of Hippocrates, as extracted from the works that have been published under his name; and, perhaps, from the view I have here given, you will not be disposed to entertain a high opinion of either his judgment, industry, or talents; but, before passing such a decision, we ought to recollect what he said to Democritus,—That he seldom had attended to these subjects.

Wherever he has bent the force of his mind, it is generally acknowledged that he there shines with unrivalled lustre; and, indeed, candour obliges me to say, that, were I now permitted to digress, to compare him with those of the age in which he

* Περὶ ἐνυπνίων, cap. i. Περὶ Διαίτης, cap. vi. *v.* 24, et cap. vii. *v.* 3, 4.

† Περὶ ἀρχῶν, cap. ii. and Le Clerc, p. 1. b. iii. ch. ii.

lived, and to point out other parts of his works, where his ardour for knowledge, his indefatigable spirit for investigation, his clearness of discernment, his quickness and extent of comprehension, his powers of reflection, and singular talent for accurate observation, appear so conspicuous, they would shew he had a mind that was formed for rising to distinction and eminence in any age; that he justly was entitled to that fame which he has acquired as the Father of Physic, and must ever be considered, by impartial judges, as among the first of illustrious characters who have done honour to mankind and to science.

LECTURE THIRD.

TILL the time of Hippocrates, whose Anatomy and Physiology we have been examining, Physic was considered as one of the subordinate branches of Philosophy. Hippocrates is the earliest writer upon record who made it the object of a separate study. From this we may infer, that most of those who, before his time, had any claim to the title of philosophers, must have been acquainted, more or less, with the animal economy; but, as it would be neither instructive nor amusing, to enumerate all who turned their attention to this subject, I shall restrict myself chiefly to those who have made discoveries, given valuable hints, or extended the views of its utility.

Among these, I must not omit Socrates of Athens. This celebrated moralist was the first who perceived the use of Anatomy in establishing the principles of natural theology, and the first who demonstrated, from the form and situation of different organs, the wisdom and foresight of the Author of Nature. The same subject was afterwards resumed, and adorned by the manly eloquence of Cicero, in his well-known work *De Natura Deorum*; and has since, from the numerous and extensive improvements of natural theology, become a most useful, and a very interesting branch of philosophy.

Plato, the friend and pupil of Socrates, a man of taste, eloquence, and genius, of luxuriant fancy, metaphysical acuteness, and possessed of all the learning of his time, though too speculative for an accurate observer, likewise bestowed a portion of his time on the animal economy. As he wanted that cool persevering patience which is necessary in physical investigations, and chose rather to fancy than trace the operations of nature, his knowledge of the structure was consequently imperfect. We must not therefore expect, in his works, to meet with any minute descriptions of particular organs; and if, in attempting to explain their functions, he sometimes approaches near to the truth, it seems to

be rather from fortunate conjecture, or the hints of others, than from actual inquiry. He imagined that the brain was a production of the spinal marrow; that the spinal marrow—a notion that has some resemblance to truth—was the first organized part of the embryo, and the bond of union between soul and body.

He calls the heart the source of the veins, and the fountain whence the blood is circulated through all the members. The blood he names the pasture of the flesh, and adds, that, for the sake of nourishing the remotest parts, the body is opened into a number of rivulets, like a garden well stocked with canals; that the veins may, by this means, receive their supply of vital moisture from the heart, and convey it through all the sluices of the body. This passage is quoted by Longinus, as an instance of the sublime; and some have dreamed that they saw in it no less than the discovery of the circulation. Plato, however, nowhere says that these rivulets returned to their fountain: the blood was carried round through the body as streams are carried round through a garden. He knew not the functions of one half of the large vessels employed in the circulation of the blood; for he imagined that the arteries were air-vessels—an opinion that led him, with

Empedocles, to confound the function of respiration with that of perspiration, and to suppose that the skin, as well as the lungs, was an organ of breathing.

As his philosophy excluded a vacuum, he believed that the air which issues from the lungs, and through the pores of the skin, gave an impulse to the air surrounding the body; which ambient air, entering the lungs, returned by the pores, or, entering the pores, returned by the lungs in the course of a semicircle. It is very evident, both from his reasoning and mode of expression, that he neither understood the functions of the heart, of the lungs, nor of the skin.

He is the first, so far as I know, who attempts to account for the colour of the blood, and who imputes it to the action of the fire residing in the left cavity of the heart.

To explain the gradual decay of the system, he supposed that prime matter underwent its first change by passing into bodies of triangular shapes; that of these bodies the elements were formed, and constituted regular geometrical figures—the Fire a pyramid, the Earth a cube, the Air an octoedron, and the Water an icosoedron; that as the body was composed of these elements, their angles, in the

course of time, would be blunted, and that no longer able to retain their hold, the fabric would dissolve, and the soul, like a ship loosed from her cables, left to drive at pleasure.

Another phenomenon, equally striking as this dissolution of organized bodies, and a phenomenon seldom alluded to by modern materialists, seems to have particularly attracted his attention. Pythagoras had taught that the soul passes into new bodies, and sometimes into bodies of a different shape; but no one thought of explaining how bodies, composed of the same materials, are infinitely diversified as to their forms, how these forms are divided into species, and how those belonging to the same species always present the same permanent and uniform characters. To account for this singular fact, Plato supposed that, besides matter and mind, there were certain substances which he calls ἰδέαι, a sort of moulds in which matter is cast, and which regularly produce the same number and variety of species in the animal, mineral, and vegetable kingdoms. As such an immense diversity of forms, belonging to bodies of the same materials, cannot be explained by any known properties of matter, and as a number of our modern philosophers, unwillingly, have recourse either to a deity or a vital principle, they

industriously avoid making any inquiry into the cause. Plato, instructed by one of the greatest and wisest of men, was a philosopher of a different description: he believed not only the existence of a deity, but in the existence of a vital principle that existed before the body was formed, and that would exist after the body was mouldering in the dust. Nay, instead of one vital principle, from observing the differences between reason, instinct, and passion, he went so far as to maintain the existence of three in the same person—one for each of the great cavities in the human body,—placing a rational one in the head, a courageous one in the heart, and a third, of low grovelling appetites, in the belly, to which the liver served as a mirror to reflect certain spectres or phantoms.

These principles have, in many respects, a strong analogy to the dynamies of Hippocrates, while his dynamies seem to have sprung from the old superstition, which committed the charge of each of the organs to a tutelary Genius. These genii were converted into dynamies, these dynamies into what the Latins call *facultates* or *vires*; and hence the faculties of our metaphysicians, and the *vis genetrix*, the *vis concoctrix*, the *vis medicatrix*, and the other *vires* of our physiologists. They are known in Eng-

lish by the name of Functions. Harvey denominates them *sensus proprii:* Blumenbach has sytled them the *vitæ propriæ:* Hippocrates subjected them to physis, or nature: Plato reduced them to three souls: Galen to three dynamies or faculties; while Bichat has lately acquired reputation as a discoverer, by converting two of the three into one.

The next person who falls within the subject of our present inquiry, is Aristotle, the son of a physician, one of the family of the Asclepiades, and so distinguished for his genius, in the school of Plato, that this philosopher used to designate him by the name of INTELLECT;* yet he had neither the glowing fancy of Plato, which painted as it wrote, and which liked to embody and to colour thought, nor the happy talent which Socrates possessed in making the abstruser parts of philosophy familiar and easy. Socrates appeared to have made his discoveries, without an effort, as freely as if the genius of nature led him by the hand, removed the veil which concealed her mysteries, and bade him listen till she taught him their nature, origin, and uses. Yet Socrates and Plato had their favourite walks. Aristotle trode in every path that led him to science;

* See Enfield's Hist.

was distinguished as a critic and a physician, as a naturalist and as a metaphysician. No man had ever displayed a more clear, comprehensive, or arranging mind. Persevering and ardent in pursuit of knowledge, and generalizing his ideas as he went, he grasped at the whole circle of science, and, to bring this whole under one view, tried to arrange all the various objects of thought, whether relating to matter or mind, and reduce them to a small number of classes. As ages before, and a great many of the ages succeeding, had never seen his like, his works were revered as the dictates of an oracle, and himself considered as something superior to the human race. Nor was it by addressing himself to the fancy, the humours, and the passions, that he acquired this singular ascendancy. Cool and dispassionate in all his inquiries, he despises trope, metaphor, and figure; has not a thought that is redundant, nor makes use of a word that is not necessary, but, quick in discernment, and accurate in conception, he was one of the most artful reasoners that have lived, and could as easily subdue the mind by the superior vigour of his intellect, as his pupil, Alexander, did the nations around him, by the decided superiority of his arms. He has fallen, indeed, it must be confessed, into several

errors; but let those who presume to laugh at his ignorance, only reflect, that had they been placed in his situation, they might never have risen above mediocrity, and that had he enjoyed but half the advantages which they possess, he still could have risen among his contemporaries to the highest eminence in literary fame, and perhaps might again have dictated to the world as he once did before.

Among the objects of his various research, anatomy and natural history were not neglected. At the request of his pupil, Alexander the Great, and assisted by a sum of no less than 800 talents, he undertook the History of Animals, employed men in every part of the Grecian empire to collect for him as many as they could of birds, fishes, quadrupeds, and insects.* From their observations, and from his own, he has been able to arrange them into classes; to mark their form, dispositions, and habits; their attitudes, their motions, and their peculiarities in the mode of generating which distinguish each. His observations are in general excellent, and prove that great superiority of intellect on which Plato, Cicero, and Pliny have bestowed such eulogiums. Although his distinctions be not always adopted, yet many are re-

* Aristoteli longe majori Viro quam vulgo creditur. Elementa Physiolog. Vol. I. p. 298.

tained. Both the paths and objects of inquiry are clearly marked out, and, at the time, his History of Animals not only diffused his spirit of enthusiasm, but abridged the labours, and furnished a number of most valuable hints to succeeding naturalists.

He likewise inquired into the internal structure of animals, wrote a particular treatise on Anatomy, and gave a nomenclature for that subject, which is now lost. He appears to have examined with attention and minuteness, a variety of the organs; has observed their form, situation, and structure; and has furnished a number of names and distinctions, which are still found of considerable use. As he quotes Alcmeon, Empedocles, Democritus, whose works are lost, it is difficult to say how much he discovered by his own observation, or how much he borrowed from his assistants and his predecessors. At any rate, whatever might have been his improvements, we must still ascribe to the Samian philosopher the distinguished merit of being the first who directed his countrymen to these subjects.

We come, now, to rather an unpleasant part of our task—to point out some of his defects, arising not from inferiority of talent or industry, but from the state of science in his time. Notwithstanding his acquaintance with the structure, his physiology

was nearly as imperfect as that of Hippocrates. He imagined that the blood was principally confined to the veins; that the arteries, besides, contained an aerial spirit, and were the immediate organs of motion; while the muscles were only organs of sensation. On this hypothesis, the brain and nerves had none of these functions to perform which are now ascribed to them. In his opinion, the brain, therefore, was a mere mass of water and earth, for exhaling vapours, and designed to assist the lungs and the windpipe in regulating the degrees of animal temperature.

He believed that the heart was not only the fountain of the blood, and origin of the veins, but likewise the origin of what he calls Νευρα, a term in which he includes the arteries, and sometimes the nerves, ligaments, and tendons. Placing the soul in the left ventricle, from whence it diffused its influence through the arteries, he makes it also the organ of motion, sensation, and nutrition of the different passions, and of the vital flame.

He explained respiration, or, more strictly speaking, the mode in which respiration is performed, by supposing that the heat expanded the air contained in the lungs, and that the external air rushed in to prevent a vacuum.

His notion of digestion was nearly the same as that of Hippocrates: he imagined that the stomach was a passive organ, in which the elements are boiled, stewed, or concocted, but that it was assisted by the heat of the liver, the spleen, and the viscera lying in the neighbourhood; that the liver, however, the spleen, and the kidneys, served also as cushions to the arteries and veins.

Although he has written at some length upon generation, he has many doubts concerning the use and importance of the testes. He has asserted that they prepare the seminal fluid by a *vis insita*; but again seems to think that in many animals they are rather organs of convenience than use; that nature designed them chiefly as a counterpoise to prevent the retractions of what is called the spermatic cord; that some animals, accordingly, have been able to procreate after castration, where the cord was not retracted, and that serpents and fishes, which, in his opinion, had no testes, are abundantly prolific.

His vital principle, like that of Hippocrates, was fire of the same nature as the pure element of the stars. Its residence was the left ventricle of the heart, but, prior to conception, it lodged in the seminal fluid of the male; and though he be very

doubtful on the subject, he sometimes thinks, that, with the assistance of his formal cause, not unlike in its functions to the *Ideai* of Plato, it constructed the body, and thus formed a habitation for itself.

I shall now take leave of this great man, in simply observing, that, notwithstanding his many imperfections, he did much for both anatomy and natural history, and more, perhaps, than any other of the human species, excepting such as a Haller or Linnæus, could have accomplished in similar circumstances.

The general ardour which he diffused for these kinds of studies, induced many others to imitate his example. Soon after, Diocles of Carystes wrote on the method of dissecting animals; and, as the knowledge of anatomists increased, the language used by Hippocrates and Aristotle was found insufficient to convey their ideas with accuracy and precision. In the time of Hippocrates, the same word denoted, in a vague and general sense, a vein, a nerve, or a glandular duct; while the word *neuron** signified an artery, a nerve, a ligament, or a tendon. Praxagoras of Cos, by restricting and defining the meaning of the terms employed to signify a vein and an artery, introduced an improvement in

* The same word in Hippocrates is applied to a vein, the optic nerve, and the ureters.

the mode of conveying accurate ideas, of much more importance than one would at first be apt to suppose.

Among the most zealous and the most illustrious encouragers of anatomy, and of natural history, it would be inexcusable to omit the name of Alexander the Great. It was at his particular request, and at his expense, that Aristotle undertook the History of Animals. Besides, his example induced other sovereigns to patronize and encourage these studies. Accordingly, his views were afterwards adopted, and eagerly pursued, by his successors, the Ptolemies in Egypt; and it was alone, through their princely interference, that anatomists first had an opportunity of examining the structure of the human body: and, certainly, without such a protection, no private individual could have ventured with safety. For it appears, from a passage of Euripides, quoted by Riolan,* that the Greeks entertained the same prejudices as the Jews, Egyptians, and other nations, against the dissection of their own species.

The principal anatomist employed by the Ptolemies, was Herophilus of Chalcedon, or, if we be-

* Riolan, Anthropag. Lib. I. cap. xiii. quoted by Portal, Vol. I. p. 77.

lieve Galen of Carthage, of Chalcedon or Carthage. He is allowed to have been one of the pupils of Praxagoras, and to have principally directed his attention to the study of the brain, the spinal marrow, and the nerves that issue from them. Hippocrates had mentioned two membranes enveloping the brain; Aristotle its division into two halves—a cavity in the middle, and a smaller brain in the back of the head. Herophilus describes, with additional accuracy, all they had seen, and, besides, a variety of other parts which they had overlooked. Yet his more extended knowledge of these organs was nothing to his great discovery of their functions, which justly constitutes one of the eras in the history of anatomy. Instead of the brain, the spinal marrow, and the nerves that issue from them, being mere masses of water and earth for exhaling vapour, as Aristotle thought, Herophilus demonstrated that they were the organs from which all the rest derive their life, sensation, and motion. Nor did he confine his attention to these: he characterized the arteries and veins by the thickness of their coats; was the first among the Greeks who wrote a particular treatise on the pulse; strongly recommending geometry and music to those who would presume to form a prognosis from the different

varieties of its pulsations. He was also the first who founded a medical school at Alexandria, and the first anatomist who taught osteology from the human skeleton.*

About his time flourished likewise Erasistratus of Ceos, a disciple of Chrysippus, and a relation of the family of Aristotle. He is mentioned as one of the principal physicians at the court of Antiochus, in Syria, and whether patronized by that prince, or by one of the Ptolemies, he, as well as Herophilus, had frequent permission to examine the bodies of condemned criminals. He was acquainted with the functions of the brain; says that its different cavities communicate; speaks of the distribution of the nerves, and considers them as the primary organs of sense and motion. Galen allows that he first discovered the valves of the heart, and those which are placed at the commencement of the two great arteries. But if Galen be correct, that treatise entitled περὶ καρδίας, in the works of Hippocrates, and in which these organs are mentioned, cannot be genuine. He is the first who asserted that digestion is performed by the action of the stomach, and the next to Herophilus who

* See Le Clerc, p. 130. See also Douglas.

saw vessels conveying the chyme from the intestines; though both saw them as if they saw them not; neither tracing their connections, following their course, nor attempting to explain their peculiar functions. He was more accurate with regard to the liver, and asserted that the blood was distributed through it for the secretion of the bile. He confuted also an absurd opinion which Plato had adopted, from his mistaking a passage of Hippocrates, that a portion of drink passed through the windpipe into the lungs.

In a fragment of his works quoted by Galen, from whom we have nearly all the information that we possess of him, or Herophilus, he speaks of a happy disposition of the muscles for the movement of the limbs. From this we may presume, that the function of the muscles was then known; and, as neither he nor Herophilus have claimed the discovery, that it also was known before their time. The vague manner in which Hippocrates writes on this subject; his ascribing the power of motion to the ligaments, and his saying that the muscles of the lower jaw are moved with the bone, preclude the idea of his being in the least acquainted with their functions. His attempt, however, to explain the phenomena of animal motions, is an evident proof

that, in his opinion, the cause was worthy of investigation; and it is rather surprising that he, but particularly Aristotle, who considered the explanation of these motions of so much importance, that he has written two books on the subject, should, notwithstanding, be ignorant of the organs from which they more immediately, and I almost might say, obviously proceeded. But indeed the ignorance of Aristotle here, is another proof of how little the structure had been investigated in his time: the motions were then ascribed to the Neura, and Neura signified, indifferently, ligaments, tendons, or arteries. The arteries were the neura to which Aristotle was naturally led to ascribe the motions. Their pulsations were felt through almost every part of the system; they had their origin in the left ventricle, where Hippocrates had placed the fountain of life and of animal heat; and, being generally found empty at death, they were supposed to contain only certain vital and aerial spirits, which regularly flowing from the fountain of life, diffused heat, animation, and motion, through the whole members. This variety of functions ascribed to the arteries, you will easily perceive, superseded the functions of the brain and muscles, and fully explains the singular notions which Aristotle enter-

tained of the brain and heart. Fortunately for anatomy, these notions were soon laid aside for others that were founded on repeated dissection and actual observation.

Aristotle, preceptor to the Prince of Macedon, had, at least by his works, excited a very strong curiosity to investigate the causes of these animal motions. Accordingly, one Lycus of Macedon, a very early writer, *Anatomicus Antiquissimus* he is called, turned his principal attention to this subject, and at last made the important discovery, that all these motions are performed by the muscles. In a voluminous work on Myology, which he afterwards published, he assigns four muscles to the eye, and though this work was but little known during his lifetime, it, according to Galen, had a wide circulation after his death, notwithstanding the deficiencies that might have been expected in a first attempt.

From having restricted myself in these Lectures, to the leading improvements in anatomy and physiology, I cannot return to the disciples of the Alexandrian school, which, though it produced many distinguished characters in physic and surgery, yet, as their lives are marked by no discoveries in these two branches, I am under the necessity of passing

from Lycus, over a period of nearly three centuries, till we come to Marinus.

This author lived in the first century, under the emperor Nero, and, in order to supply the deficiencies of Lycus, resumed the subject of myology, carried it to a higher degree of perfection, and was the first who suggested the real use of those bodies which we now call Glands.

Soon after, about the beginning of the second century, Rufus Ephesius, either from observation or dissection, was led to conclude, that the arteries, in their natural state, did, besides air, contain also a quantity of blood. Some blood had also been found in them by Erasistratus, but, rather than renounce the old and generally received hypothesis, that they were air-vessels, he endeavoured to account for the appearance, by supposing a fact, of the truth of which he was not aware, that the veins and arteries communicated at their extremities, and that when the arteries were emptied of their air, the blood rushed from the branches of the veins, to prevent a vacuum, but was always attended with some morbid effects on the system. The ideas on anatomy had again accumulated, so as to require some improvements on the language; Rufus Ephesius was, therefore, led to compose a work, that is still

extant, entitled *Onomasia*, in which he enumerates and defines the terms that had been used by his predecessors: and we learn from him, that, although Herophilus and Erasistratus had ascertained the functions of the nerves, they still allowed the word Neura, by which they were expressed, to retain the same various meanings which it had before; contenting themselves with characterizing the species they intended, by particular epithets. His Onomasia may also be considered as the best view of the state of anatomy before Galen.

The illustrious Galen was a native of Pergamus in Lesser Asia, was born in the time of the Emperor Adrian, and flourished under Trajan, Marcus Antoninus, and some of their successors. He was a person of uncommon genius, great industry, and profound erudition. Being early initiated in general literature and the fine arts, and having studied with unusual diligence in all the philosophical schools of his time, he at last conceived a passion for physic, and, to prosecute his studies, went to Alexandria, the most celebrated seminary of that kind then in the world. He there had opportunities of frequently examining the human skeleton, but, finding that the practice of dissecting the human body had been laid aside, to supply the deficiency, he employ-

ed himself in dissecting animals that bore the nearest resemblance to man, and in comparing their structure with that of birds, quadrupeds, and fishes. He confesses that he never had dissected insects or minute animals, although, with a view to understand the functions, he frequently had opened animals alive. Being a man of affluence and rank, and enjoying all the possible advantages of a liberal education, extensive reading, and much travelling, he has been able to collect the information of all his predecessors; and, from great industry, and much observation, has given a fuller description of the bones, the ligaments, the muscles, the nerves, the bloodvessels, and viscera, than any preceding author on the subject. Portal is so partial to his Anatomy, that he thinks it superior to a great many elementary books of a later date, but particularly to many of the present day, and requests us only to draw the comparison, to be convinced of the justness of a criticism which is so disgraceful to our modern compilers, and even humiliating to the age in which they live.

It might here be improper to mention any of his lesser discoveries among the leading facts of the science. I shall, therefore, confine myself to a few which are of importance. He was, next to Aristotle, the first who doubted, and completely over-

threw the old and generally received opinion, that the arteries were air-vessels,—an opinion that carried along with it, in its fall, systems of pathology and of physiology that had lasted for ages, and become venerable even from their antiquity. Next to Aristotle, he is also the first who mentioned a communication between the branches of the veins and arteries, in the substance of the lungs, and a passage of the blood, by that communication, from the right to the left ventricle of the heart;—the first who mentioned the peculiar structure of the foetal heart; and the first who clearly demonstrated the larynx at the top of the wind-pipe, and showed it to be the organ of voice.

His physiology, more generally known by the title *De Usu Portium*, composes a separate treatise. It was intended as a hymn to the Creator; does much honour to his head and to his heart, and, from numerous displays which are there made of divine power, wisdom, and beneficence, he boasts of having presented to the Deity, an offering more acceptable than hecatombs of oxen. His notion of the *anima* or vital principle, that regulates the whole economy of the system, is borrowed from Plato's Three Souls. He has three spirits, which are the instruments of three faculties,—the natural, ani-

mal, and vital. The natural faculty occupies the liver, and presides over growth, nutrition, and generation; the vital faculty is placed in the heart, and is made to distribute, through the channels of the arteries, life and heat; the animal faculty, whose residence is the brain, regulates the whole, and conveys, through the medium of the nerves, sensation and motion. Besides these, he has other faculties, of inferior note, whose office is limited to particular organs, the same as the *sensus proprii* of Harvey, or as the *vitæ propriæ* of Blumenbach, whose modern discovery consists merely in the change of name; for these *vitæ*, as well as the two *vitæ* of Bichat, were, excepting the names, just as well known to the ancients as the four temperaments.

Of these temperaments, which still make a figure in modern pathology, I promised, in one of my preceding lectures, to take some notice when I came to Galen. Most of you know that the ancient mythologists, in trying to explain how the world was originally formed out of chaos, made use of four elements,—fire, air, earth, and water; and four qualities,—hot, cold, dry, and moist. As these were the great agents in nature, and, at that time, found necessary to explain every phenomenon, it was not

to be wondered that they likewise should be called in to explain the functions of the human body. The four qualities were accordingly given to four humours,—a sort of four secondary elements that were supposed to exist in the body. According to Hippocrates,* these were bile, blood, phlegm, and water; or, as he more generally seems to think, blood, phlegm, a yellow bile, and a black bile. To each of these, he, or rather his predecessors, for they were known before his time, gave two of the qualities which we have mentioned, so that the blood was hot and moist, the phlegm cold and moist, the yellow bile hot and dry, and the black bile cold and dry. But, to these qualities, Hippocrates added a great many others, particularly the sweet, the salt, the bitter, and austere. He made, besides, his humours and qualities to vary greatly in their proportions, and his qualities in their degrees of intensity, and supposed these variations to arise from a prodigious number of circumstances; from every difference of age or sex; from the difference of the sun, moon, and planets, in every possible position and aspect;† from the changes of the

* De Morbis, lib. iv. cap. 25, *v.* 28.

† See Index of Hippocrates, in *Astra, Luna, Sol,* and the parts referred to.

season, and from every slight variation of the weather. The changes arising in this way, from the various combinations, proportions, and degrees of four humours and eight qualities, to make no more of them, can easily be shewn to amount at least to four hundred and seventy-nine millions, one thousand, and six hundred; and yet to practice with infallible success, it was necessary to know and distinguish each of these numerous changes. But, as that was impossible, Hippocrates chiefly directed his attention to four changes, produced by the varying proportions of the humours. These changes were called temperaments, and were sanguineous, phlegmatic, bilious, or melancholic, according to the humour that predominated at the time; and were limited to four, in order to correspond with the four elements, the four great ages of the world, the four periods of man's life, the four seasons of the year, and, above all, with the meaning of Tetractys, a mystical word, in the language of Pythagoras, that signifies a quaternion or group of four. That Hippocrates should have embraced these opinions, considering the schools in which he was educated, or that Galen should have followed him, from the high veneration which he always entertained for the divine old man, is not surprising; but what

excuse can we possibly bring for some modern pathologists, who, after entirely rejecting the sense of these ancient writers, would sooner renounce their religious creed than part with the terms in which these antiquated notions are expressed?

But leaving this fantastic pathology, I shall now return to those objects in which we are more interested. The vast collection of historical, medical, and anatomical facts, contained in the works of Galen, arranged with all the correctness of a critic, and with all the abilities of the first and most accomplished scholar of his time, made such an impression on the minds of his followers, that, rather than excite them to emulation, it inspired them with a sort of reverence and awe. For many ages there was no person who presumed to dissent from him, who dared to equal him, and far less to excel him. Physicians, surgeons, and anatomists, had no ambition beyond that of studying his works, abridging, copying, or commenting on them. They fell into the hands of the Arabians at the taking of Alexandria in 640. They too began to admire them, and translated them into their vernacular language, but, without thinking of bringing his descriptions to the test of experiment, or of making any additional improvements, became as servile imitators as others. In the east, however,

his name and reputation, in this way, continued to flourish, while the translation of the seat of empire from Rome to Byzantium, and the future inroads of barbarous nations, had well nigh extinguished his memory in the west. For a period, therefore, of considerably more than a thousand years, no discoveries were made in anatomy that deserve to be mentioned in this place. We principally owe the recovery of his works, the revival of anatomy, and literature in general, to one of those singular mental contagions, which, from the smallest and most trifling beginnings, seize on the mind of every individual, and as rapidly spread over nations and empires as the plague or influenza which attacks our bodies: I allude to that mental contagion which produced the Crusades. In these expeditions, which continued occasionally for some hundred years, many adventurers became acquainted with Arabian literature and the writings of Galen, and, through this channel, Anatomy again found its way into the west, where it first was cultivated by one Mundinus, a Milanese. He had got acquainted with the writings of Galen through the impure medium of an Arabian translation, and, wishing to illustrate the descriptions of the Grecian by actual dissection, he made several remarks of his own, and,

about the year 1315, published the result of his inquiries under the form of a regular system. The attempt was rude, and many of the terms which he used were Arabic, but its novelty attracted general notice, and, as there was nothing of the kind to equal it in any language that was understood, it was soon held in so great estimation, that the statutes of Padua, for some time, allowed no other system to be taught. It certainly contributed to raise a spirit for anatomical inquiries; and, for some time after, one of the surest roads to fame was to publish it with commentaries. Still, however, the reviving genius of Greece was feeble, until it received an accession of vigour in 1453, when Constantinople was taken by the Turks. Upon that catastrophe, Theodore Gaza, Argynophilus, and others, fled to the west, and took refuge in Italy, where Emanuel Chrysoloras had been employed in diffusing knowledge some time before. These learned men carried along with them a number of valuable Greek manuscripts, and rescued from obilvion a great many others that had lain buried in the libraries of the west. About the end of the same century, this new spirit received another additional impulse from the discovery of the art of printing; and, about the beginning of the sixteenth century,

many eminent anatomists arose, not only in Italy, but in Germany and France. Among these, James Berengarius of Carpi, and professor at Bononia, who had dissected a great many bodies, published a system of such reputation, that he was called the Restorer of Anatomy, while his contemporary, Charles Stephans, brother to the printer, and the intimate friend of our countryman Buchanan, greatly improved that branch of anatomy which treats of the ligaments and bones: Fernelius, that branch which treats of the bloodvessels; and Gonthier Andernach, that which treats of the muscles. But still improvement was in some measure checked by the high veneration that was paid to Galen; for he still continued the sole dictator in the schools both of Anatomy and Physic, until Andrew Vesalius boldly presumed to question his authority.

This very extraordinary man was a native of Brussels, of a bold, keen, enterprizing disposition. Even when a boy, he showed a most determined passion for anatomy, and was indefatigable in what he undertook. Enjoying likewise the many advantages of an easy fortune, he neglected none of those opportunities which it afforded to cultivate his mind, and to qualify himself for the farther prosecution of those studies to which nature had led him by the

most unexampled and ardent enthusiasm. In a short time he made himself acquainted with the ancient Hebrew; and was such a master in Greek and Arabic, that before he was twenty, he read the works of Avicenna and Galen in the original; spoke the Greek even with facility, and wrote Latin with more ease, and with more elegance, than any of his time. Early versant in practical anatomy, robbing the gibbets, regardless of the grave, and dissecting bodies even in his bed-chamber, he soon perceived, that many descriptions to be found in Galen, had been taken from quadrupeds; and, not disposed to conceal his acquirements, he began openly to dispute the authority, to correct the mistakes, and to censure the errors of the Grecian master, and finally resolved to favour the world with an anatomical system of his own. Accordingly, in the twenty-fifth year of his age, having already given public lectures in several universities, he commenced his great and immortal work, and, after overcoming a number of difficulties, which, to any other person, would have been insurmountable, he finished it in the course of three years. In point of arrangement, copiousness, and accuracy, nothing, as yet, had ever appeared so complete on Anatomy; but as it contained many severe censures on Galen, this roused

the indignation of his numerous admirers, who, examining Vesalius with the eagerness of critics, discovered similar mistakes in himself, and probably not a few of their own. The spirit of controversy, which was thus raised, only led to more accurate inquiry. The work of Vesalius remained unrivalled, and at last was successful in dispelling that enchantment in which an excessive veneration for Galen had held anatomists for so many ages.

In his time, the passage of the blood from the right to the left ventricle of the heart was unknown. Vesalius demonstrated that it could not pass, as had been supposed, through the septum that divides them: anatomists, therefore, were under the necessity of looking out for some other way. His pupil, Columbus,* endeavoured to demonstrate, by a process of reasoning, that it went through the lungs; and something of the kind had also been insinuated by Galen,† and afterwards by Nemesius, bishop of Emessa;‡ but was plainly asserted by Vasseur or Vasseus, a Frenchman,§ and more plainly still by Servetus,

* Columbus *De Re Anatomica*, lib. xi. cap. 2.

† The passage of Galen is quoted by Harvey.

‡ Still more obscurely than by Galen. See 24 Περὶ Σφυγμων, or *de Pulsibus*. Nemesius Περὶ Φυσεως ανθρωπου.

§ The passage of Vasseus is cited by Portal.

a Spaniard.* This passage of the blood through the substance of the lungs, from the right to the left ventricle of the heart, has received the name of the Lesser Circulation. It was well known to Andrew Cæsalpinus, an Italian anatomist, who went still farther, and asserted, that the blood which issues from the left ventricle of the heart, returns to the right by means of the veins ramified through the system. Unfortunately, his opinion, though perfectly correct, was founded on hypothesis as much as on observation; and his having embraced a notion of Aristotle's, that the blood flows backwards and forwards in the same vessels, like the tides of Euripus between Attica and Eubœa, prevented him from making any farther discovery. But a great discovery was not far distant. Very nearly about this time, Fabricius *ab Aqua Pendente*, a professor of Padua, induced by some appearances which he saw in the arm, upon tying the ligature in venesection, laid open the whole course of a vein; and, in 1574, observed certain membranes within it, which he called Ostiola, or Little Doors. These membranes, as he thought, having accounted for the appearances which he saw in the arm, he pro-

* The passage cited by Portal.

ceeded to lay open some other veins, when he perceived similar membranes in all the veins of the extremities, but none in the veins which run through the trunk. Having at last frequently observed and examined these membranes, he published an account of them, describing their form, situation and structure, and the distances at which they are generally placed from each other in the course of the veins. In this publication, expressing his wonder that no person had seen them before him, it was found, that nearly a century before, they had been traced through several veins of the extremities by Jacobus Sylvius, mentioned by Stephans, under the name of *apophyses venarum*, and their function assigned, to prevent the reflux of the venous blood. Nay, in the year in which Fabricius made the discovery, they were seen by Cannanus, who afterwards pointed them out to Vesalius. Fabricius, however, probably ignorant of these circumstances, laid claim to the whole merit of the discovery, and while he was continuing to demonstrate them in his class, with all the enthusiasm which discovery inspires, a young Englishman, of the name of Harvey, arrived at Padua. The singular novelty of these membranes very soon attracted his attention, and filled him with a generous emulation and ardour, to find out

their uses. Fabricius had said, that they were to the veins what joinings or knots are to plants of *vervain* and other vegetables: they served to moderate the current of the blood, as it flowed backwards and forwards in their course. His pupil, dissatisfied with this explanation, could not help suspecting that they performed a different office, and of much more importance. Having, therefore, taken his degree at Padua, and returned to England, he became anxious to resume the subject. Accordingly, procuring a numer of animals, and opening them alive, he, at last, completely ascertained the functions of the venous membranes, which, from forcing the blood always to flow in the same direction, in the same vessels, he denominated Valves: and thence was led, as he told Mr Boyle, to the noblest discovery that is known in anatomy—the circulation of the blood. It was made public in 1628, and I need not mention the great changes which it necessarily introduced into all our reasonings on the animal economy. The consequences which it had with respect to himself, are not, perhaps, so generally known.

Who could have imagined that the first effects of a discovery, which has since procured him the epithet IMMORTAL, could have been a considerable

diminution of his practice, and the violent opposition of many of his fellows in the Royal College of Physicians of London? It has been observed, that no man above forty years of age, at that time, was made a convert to the new doctrine. Prejudice and envy everywhere opposed it. Their first attempt was to deny it; and when they discovered that this was impossible, they next laboured to find it in Hippocrates: but being here, likewise, disappointed, they went to Plato, from Plato to Nemesius, bishop of Emessa, from Nemesius to one Ruef, a Swiss, who had not even dreamed of the matter, and from Ruef, at last, to Andrew Cæsalpinus, where they found themselves to be equally mistaken. Chagrined now, and provoked with disappointment, they next began to detract from its merit: They said the foundation was laid by Fabricius *ab Aqua Pendente*, and that little more was left for Harvey to do than to dress it up into a system, which required no extraordinary talents. They have introduced him with Copernicus and Columbus, to show that his merit, as a discoverer, was comparatively low. They have added, that none of his writings show him to have been a man of uncommon abilities, and say, it were easy to quote many passages which bring him nearly to a level with the rest of

mankind. They have even insinuated that he was chargeable with obstinacy and envy; and observed, that though he lived almost thirty years after Aselius published the Lacteals, yet to the last he seemed to think that no such vessels existed. The best confutation of all these invidious and unmanly charges are his own works, *De Motu Cordis, et Generatione Animalium*,—works which will ever perpetuate his name in the annals of fame, procure him the distinguished character of Genius, and place him at a height that is far beyond the reach of those poisoned darts of invidious detraction.

LECTURE FOURTH.

HAVING already given an account of the leading discoveries which ascertained the functions of the muscles, the nerves, the brain, the spinal marrow, the heart, and the bloodvessels, we proceed now to mention another, in many respects more extraordinary,—I mean the discovery of a great and important system of vessels that had seldom been even partially seen, and by most anatomists was not supposed even to exist, All anatomists had traced the food from the mouth to the stomach, and from the stomach through the different windings of the intestines; but no one had ever observed a single passage by which the nutritious part of the aliment could get into the system. They had seen, indeed,

a number of veins spreading on the tube, particularly on the part which is called Intestine; and, from seeing no other, except the concomitant branches of arteries, they naturally concluded, that the veins were the vessels that conveyed the chyle; and as these, branching on the stomach and intestines, end in the liver, they gave to that viscus the office of changing this chyle into blood, and called it the Organ of Sanguification. This explanation was always considered as completely satisfactory till 1622, when Asellius, an Italian doctor of Pavia, chancing to open a live dog, observed vessels of a different nature, all commencing from the intestines, and containing a fluid of a white colour. Their white appearance led him, at first, to suppose they were nerves, but, upon farther and stricter inquiry, he saw they were the vessels destined by nature to convey the chyle, traced them as far as a large gland, or cluster of glands, which he calls Pancreas, and, from the white colour of their fluid, denominated them Lacteals. Perceiving, likewise, a few on the liver, and believing the general notions of its functions, he naturally supposed that they went to that gland, and calls them its Arms, by which it sucks up the chyle like leeches. This comparison has

given rise to a modern hypothesis, pretending to be both original and new, but which, like too many others of the present day, is *mera vox et praeterea nihil.* I shall likewise take notice of another circumstance, which would certainly appear a most singular phenomenon in our time. Asellius was so modest as to claim no merit from the discovery: he ascribes his good fortune to chance; confesses that Erasistratus had seen the like vessels in a kid, but mistook them for arteries, and supposed that, at times, they contained air.

I need not observe that this discovery of Asellius was imperfect: he only supposed that they went to the liver, and had never traced them to the fountain of the blood. This part was reserved for Pecquet, an anatomist of France, who, thirty years after, on opening the heart of another live dog, saw a whitish fluid mixing with the blood, and flowing on with a constant stream. Examining the source whence it came, he was led to discover the large trunk in which all the vessels of Asellius terminated; and, when he published, was as modest as Asellius, in cautioning his reader not to ascribe this important discovery to his superior acuteness or diligence, nor to blame the ancients for neglect or inaccuracy, declaring candidly, that his merit here

was comparativcly small, and that the whole was owing to chance, and the kindness of Providence. We can hardly imagine that a man so modest and unassuming, would, had he known it, have studiously concealed the discovery of Eustachius, who, long before, had described the same vessel in a horse, but neither knew its origin, nor use, the knowledge of which formed the important discovery of Pecquet.

Anatomists again would have been contented with what they had seen, and would not have looked for any more vessels to explain the functions of the animal system, had not Olaus Rudbeck, a Swede,* Thomas Bartholine, a Dane,† and Jolyffe, an Englishman, on opening the bodies of more live dogs, accidentally discovered numerous vessels of a like kind, arising from various parts of the body, and ending, along with the lacteals of Asellius, in the trunk of Pecquet.‡ Bartholine saw them on the liver of a fish, and Dr. Monro and Mr. Hewson have since demonstrated them in a variety of birds and fishes. In short, they are found to be a part of the animal system—the lymphatic veins which accompany the lymphatic series of arteries. From

* 1651. He saw likewise the thoracic duct.

† 1651-2. His work came out in 1652.

‡ His work appeared in 1653.

an opinion that they were branches of the same system with the lacteals of Asellius, they were named by Bartholine, *vasa lactea*, and, from the nature of the fluid which they contained, *vasa serosa*, *vasa lymphatica*, and *ductus aquosi*. The great importance of these discoveries was generally acknowledged—the difficulty of making them can only be conceived by those who are somewhat acquainted with the subject. The lymphatics or lacteals can scarcely be seen, even with the microscope, but when they are distended with fluids; and they seldom contain any fluids at all, except during the life of the animal, or a short time after its death. We ought not, therefore, to be much surprised if they escaped the observation of anatomists for so many ages, nor wonder, when the lymphatics were discovered, that physiologists should have found it difficult to assign their use. The lacteals of Asellius spoke for themselves: they were the channels by which nourishment was conveyed into the system. But what nourishment could vessels convey that arose from the very points of the extremities? Among various opinions, it was thought by Rudbeck and Bartholine, themselves, that, by suction or absorption, they were meant to convey back to the heart, all the fluids that had flowed in the smaller

branches of arteries, or that wandered from the course of the circulation, as known to Harvey, and which were not returned by the red veins. Nor was the opinion, that such an absorption was regularly taking place in all parts of the animal body, any new idea in anatomy: it was the general and well-known doctrine of the ancients, as is plainly proved by Kaaw Boerhaave, in his *Perspiratio Dicta Hippocrati.* The office, however, was ascribed to the larger or red veins. But it being obvious that the vessels of Asellius performed the office that had been ascribed to the red veins of the intestines, Rudbeck and Bartholine claimed the same privilege for their lymphatics in all the other parts of the system; while Vieussenius, a professor at Montpelier, endeavoured to show, by mercurial frictions, and from the effects of bathing in water, that very probably many of these vessels opened towards the surface, where many lymphatic arteries terminated. Similar ideas of their nature and functions had occurred to Glisson, to Willis, to Hoffman, and to M. Noquez, a French anatomist, who calls them, as early as 1737, Conduits Absorbents, or Absorbing Vessels. And the same doctrine has been farther confirmed by two very distinguished anatomists,—the late Dr. Hunter of London, and the

late Dr. Monro of Edinburgh, who, somehow or other, have warmly disputed about the merit of suggesting a thought that occurred to anatomists before they were born. Yet they both have had the merit of arranging the scattered ideas on the subject into a system—a merit of no inferior degree thought Dr. Hunter, when that merit was his own, but a merit implying no more than ordinary talents, when it was considered the only merit of Harvey.

As this system of absorbents or lymphatic veins is the last great and leading discovery made in Anatomy by means of dissection, before we proceed to those which have been made by the application of geometry and chemistry, we shall take a view of the principal improvements that have been introduced in the way of demonstration. As verbal descriptions do not always convey accurate ideas of the things described, surgeons and anatomists early thought of supplying the defect by pictures or figures. This discovery, by some, has been ascribed to the celebrated Italian, Leonardo da Vinci, not only a philosopher, but a painter and anatomist, who lived about the time that engraving was invented, and died in the beginning of the sixteenth century; but, however great his merit might be in other respects, he is not entitled to this honour.

Moschion gave some surgical figures in the third century; and Guy de Chauliac, who flourished in the fourteenth, says that Hermondaville, who lived before him, taught anatomy from figures, at Montpelier. But whether anatomy was taught so or not, it is plain, from the expression of Guy de Chauliac, that anatomical figures were used in his time; and Montagnana, who, according to Portal, flourished about 1440, is the author of an anatomical work, accompanied with some excellent plates. About the beginning of the sixteenth century, when the art of engraving was not only known, but generally diffused, almost every book on anatomy was accompanied with figures; of these we may mention the works of Peiligh, Hund, Carpi, Stephans, Dryander, Sabio, Vesalius, Viringus.

Such figures are exceedingly useful when the originals are not to be had; but, to study plates when the originals may be procured, is so far from bespeaking a taste for anatomy, that it scarcely implies an ordinary share of common understanding. Even the best are only aids in studying the originals; but when they are substituted for the originals, their intention is perverted—they serve only to mislead, to diffuse error, and to perpetuate it.

About the middle of the sixteenth century another acquisition was made in anatomy by the use of the

microscope. It was first used by the accurate Eustachius, afterwards employed by Grew and Malpighi, in illustrating the structure and economy of plants, and also by the latter in demonstrating parts of the animal system. To this instrument we are indebted for many discoveries of Swammerdam, Liewenhoeck, Baker, Trembley, Lyonet, and Bonnet, and for two or three foolish and absurd theories that are evidently founded on optical deceptions, particularly a theory of animalcula in the seminal fluid; of muscular motion, founded on the structure of the ultimate fibres; and a third about the intimate structure of nerves.

The last improvement which I shall mention of this kind, is the art of Injection.* It had always been found a tedious operation to dissect properly the smaller branches of collapsed bloodvessels. Some assistance was therefore necessary; and, for that reason, Jacobus Sylvius, the master of Vesalius, was wont to fill them with a coloured liquor. Eustachius† adopted a similar plan in examining

* With respect to injections, see Portal, Vol. I. p. 633-4-6. Vol. II. p. 261. Vol. VI. p. 162, &c.

† Eustachius injected, dried, and macerated his preparations, Portal, Vol. I. p. 633-4. For Boyle, see Shaw's *Abridgement of his Works*, Vol. I. p. 30. De Graaf's Work, *De Si-*

the kidneys; and a like device, on some occasions, was practised by Glisson, Bellini, Willis, Varolius, Mayow,* while Riolin was accustomed to inflate them with air. Among these the Honourable Mr. Boyle deserves likewise to be particularly mentioned. He had seen several dried preparations, and proposes different kinds of injections that would afterwards harden and preserve the veins and arteries plump. Portal informs us that something of this kind was employed by Bellini. At last De Graaf, an anatomist of Hollond, contrived convenient instruments, and, publishing his account of them in 1664, claimed the whole merit of the discovery. What remained now to be sought was a proper injection. Marcellus Malpighi had employed quicksilver; and De Graaf mentions only a number of tinctures which all flowed out on the least puncture or rupture of the vessels. His countryman, Swammerdam, saw the defect, employed

phone, appeared in 1669. In the same year Mayow's Work appeared at Oxford, where he speaks of having injected the lungs. See Mariget *Bibliothec in Mayow*. Swammerdam, in *Prodromum*, p. 38, speaks of his preparation. Anthony Mack, who injected the lymphatics at Leyden in 1691, uses the phrase, *mercurius noster*, as if he had been the first that used it. See Aderog. p. 19.

* Mayow, *De Respiratione*, 261.

wax, which hardens upon cooling, and, supposing himself the first who made use of such a material in the way of injection, to secure the reputation of such an invention, sent one of his preparations to the Royal Society of London in 1672. His friend, Frederick Ruysch, carried the art to the highest perfection to which it has arrived, made a number of valuable discoveries, and, by maceration, or rather corrosion, exhibited clusters of small vessels crowded together, yet all in situation, and without any interposing substance.

The numerous advantages that anatomy has derived from the art of injection, cannot well be described in a general Lecture. You will be fully convinced of its use when we come to that part of the course which treats of the bloodvessels.

From the general view of the discoveries made by dissection, we shall now proceed to enumerate those which have been made by the application of the mechanical and chemical philosophy, and shall afterwards inquire, how far these are sufficient to explain the several phenomena of organized bodies.

With respect to that branch of philosophy that is called Mechanical, the ancients could suppose no other way by which the appearances of material substances could be explained. So partial was Py-

thagoras to this science, that in morals and theology he expresses himself in the language of geometry; and, if the letter to Thessalus be genuine, Hippocratus himself has strongly recommended geometry and numbers to the surgeon and physician, and mentioned the cases in which they might be useful. Plato imagined that God himself was always geometrizing, and has asserted that the four elements are composed of regular geometrical figures. Galen accounted for a number of diseases, from certain changes in the number, magnitude, figure, situation, the velocity, momentum, and adhesion of the parts. And Renatus de Cartes, an eminent philospher and mathematician, biassed by some particular hypothesis, was led to infer, that the lower animals were mere machines.

These opinions were well calculated, not only to warrant, but to invite the application of geometry. At an early period, therefore, of modern improvement, Fabricius *ab Aqua Pendente,* partially applied mathematical reasoning to explain the action of some of the muscles. His plan was followed by Steno and others, and at last more successfully executed by the ingenious Borelli, in his valuable work *De Motu Animalium.* Till his time, it was generally believed, that, in muscular action, nature

produced a great force by a small effort, and that she did so by certain levers or mechanical powers, supposed to exist in the muscles or tendons. Borelli showed that no such power existed in either; that the bones, in general, were the levers of the muscles; and that these levers were of a very different form from what had been imagined. In short he demonstrated, from the general direction and obliquity of the muscles, with respectto the bones, from the place of their insertions near to the joints, and from the situation of these insertions between the fulcrum and the resistance, that nature was prodigal of muscular power, and, instead of producing a great force by a small effort, did not unfrequently employ a force a hundred times greater than the resistance which she had to overcome.

Having thus ascertained the nature of the levers, he proceeded next to calculate the strength of the different muscles, and found that many which scarcely support the weight of the lever in the dead body, do yet, in the living, exert a force equal to some thousands of pounds. All these conclusions are drawn from data universally admitted; but he had an opinion with regard to the structure of the muscular fibre, that makes their force almost incredible. On this hypothesis he makes the force of

three muscles, belonging to the hip joint, equal to no less than 375,420 pounds. His observations on the forms and movements of different animals, of men, quadrupeds, birds, fishes, and insects, are not only highly interesting to the naturalist, but might be studied with singular advantage by the medical practitioner who wishes to improve the mode of cure in luxations and fractures, or to explain the phenomena of disease where muscular action is materially concerned.

He was the first, or among the first, who clearly demonstrated the great force of a muscular stomach, and he has given many experiments that were afterwards repeated by Abbe Spallanzani, and much admired because ignorance supposed them to be new. His success in explaining muscular action, led him to apply mathematical reasoning to the other functions, both in a state of health and disease. And his friend Bellini extending it farther, was reckoned the inventor of what has been styled mathematical medicine—a discovery deemed of so much importance, that it was termed *nobilissimum atque utilissimum inventum*, and was thought by some little inferior to that of the circulation by Harvey.

This discovery, if it might be called one, found a strenuous and warm advocate in his friend Pit-

cairn, who afterwards published the *Physico-Mechanical Elements of Medicine.* The pupil of Pitcairn, the celebrated Boerhaave, and the most illustrious character of his time, from giving his sanction to many of its principles, served to establish them in the schools of physic. The animal system was now considered merely in the light of a mechanico-hydraulical machine; and a number of strange theories were formed upon the lentor and fluidity of the humours, the shape, magnitude, and gravity of the particles, and the cavities of the vessels, that were suited to certain forms and magnitudes, which, if they chanced to wander from their course, occasioned disease by an *error loci.* Warmed by enthusiasm, and blinded by their theories, the mechanical physicians could not perceive that most of their conclusions were drawn from hypotheses supported by neither observation nor experiment; and, so eager were they in the application of their favourite science, that they seemed to be offended when any other mode of reasoning was suggested. "Since the human body," said Dr. Friend, "is nothing but a fine contexture of solids and fluids, which observe the rules of mechanism, it is amazing to find that men should think of any other principles than the mechanical to explain it by." "Would any one," he

adds, "go so much out of the way, as to account for the motions of a watch, from the precarious doctrine of acid and alkali; or would he make use of the ethereal matter of De Cartes, to solve all the appearances of hydrostatics?"

Such opinions of a favourite science might indeed be natural; but they were carried to such an extravagance, and led to consequences so very absurd, that, from not distinguishing between the use and abuse of a science, mathematical reasoning has for some time past been excluded almost entirely from physiology; although, to the candid inquirer, it be obvious that its enemies have shown as much imprudence in rejecting it entirely, as Bellini and Pitcairn in extending it too far. No species of reasoning, excepting itself, could ever have explained the motions of animals, shown the force which the heart and the stomach employ in their contractions, demonstrated the effects of the blood's velocity, its momentum and quantity in different vessels, or how these are effected by the differences of the angles at which branches of vessels arise from their trunks: and I farther may add, that no other species of reasoning could have explained the phenomena of vision, the structure of the ear, the properties of sound, the mechanism of the joints, the nature of

the levers, or the admirable contrivances in the forms of the bones, by which their surfaces are greatly enlarged, and their strength increased with the least possible quantity of matter.

Having thus seen how much we owe to mathematical science, we must next inquire how much we are likewise indebted to Chemistry.—Of all the sciences, none have made bolder pretensions than this, to explain the functions of the animal system. From being at first employed in manufactures, it was brought into pharmacy by the Egyptians; and, rising to still higher distinction, was at last considered as a branch of philosophy by the Arabians, who had so high an opinion of its merit, that, with its assistance, they expected to find the philosopher's stone, that was to transmute the basest metals into fine gold, and prolong life to indefinite periods.

The first who applied it extensively in physic was Paracelsus, a man of singularly eccentric manners—keen, rash, ignorant, conceited, and notorious for that insufferable arrogance by which prosperity distinguishes a weak from a strong mind: he was so ambitious of popular applause, that he would allow no merit to any other person; and, for that reason, was particularly violent against all those of his own profession who had acquired any reputation.

Having performed some remarkable cures by mercury and opium, and excited the admiration of the ignorant and credulous, he fancied that now he was something extraordinary; and, adding cunning to his ambition, he tried to impose himself on the world, not only as the first physician, but as the first philosopher, and the first divine then in the universe: Thus easily, but idly, flattering himself, in contemptuous derision, he called Hippocrates, Galen, and Avicenna, a parcel of humourists; burned the works of the two latter publicly at Basil; threatened next to overturn the system of Aristotle, and to send the Pope, Luther, and Zuinglius, as he had done Hippocrates, Galen, and Avicenna, back to the school again.

Being totally ignorant of the art of anatomy, he affected to despise it: calls it local, material, and gross, and says that it merits little attention; but proposes a new kind of his own, which was to consist in the chemical analyses of the different organs. "This," said he, "is alone the true,—this the genuine,—this the noblest kind of anatomy." By this anatomy he expected to find the kinds and proportions of the three great chemical principles of that time—the sulphur, the mercury, and the salt. The sulphur being what ascended in flame, the mercury what

ascended in smoke, and the salt what remained after combustion.

As he believed that the animal fabric was a microcosm or little world, governed by a spirit, which he called Archaeus; so he also imagined, that, like the great world, it contained the principles of all animals, minerals, and vegetables; and, by the power of fancy, or rather assisted by the poet Manilius, who wrote on Astronomy in the time of Augustus, he discovered its sun, its moon, and its planets, and asserted it to be necessary for a physician to know likewise its east and its west, its meridian, the tail of its dragon, and its sign Aries.

It is not surprising that chemistry, recommended by such a person, should be little attended to by rational physiologists. His writings, however, which were voluminous, and much read, and by many admired, from containing some novel and useful observations, and several new chemical facts, contributed to weaken the authority of Galen in the schools of physic. In a short time chemical studies grew into such reputation, that Borelli, in his *Bibliotheca Chemica*, published in 1653, enumerates no fewer than four thousand that had been engaged in that branch of science, and yet mentions none but those

of his own knowledge.* From their joint labours, one should imagine, that much light would have been thrown on the animal economy: but Boerhaave observes, that the low character, the dissipated lives, the pretensions to magic, and the mercenary views of a great number of those who were engaged in it, retarded not only the progress of the science, but prevented mankind from reaping any advantage from their labours. The mechanical philosophers, jealous of encroachments, were not disposed to overlook the circumstance; and part of the odium, so justly attached to the character of the men, was, in some measure, transferred to the science, and chemistry rejected from physiology.

Among its restorers we are chiefly indebted to the Honourable Mr. Boyle, Homberg, Mayow, Geoffrey, the Younger Lemery, Stahl, and Hoffman. Boyle, the earliest of these writers, not only analysed a considerable number of animal substances, but pointed out several advantages which anatomists might derive from the study of this art. He was likewise the inventor of what has been called the Pneumatic Philosophy, so much studied by Mayow and Hales, and so much improved by our Dr.

* Boerhaave's *Hist. of Chemistry*, Vol. I. p. 45, note 8.

Black, whose merits as a chemist will perpetuate his memory to latest ages. By this, and other successive discoveries, chemical analysis has been carried to a high state of perfection; and modern chemistry has already ascertained, in a much more satisfactory manner than was done before, the component parts of many of the animal solids and fluids; and farther, having shown, that, in many cases, they vary their proportions according to age, health, and disease, it has furnished us with some new ideas respecting the changes which regularly take place in the animal economy.

But, besides ascertaining the nature of these changes, chemistry has added important information respecting two of the principal functions,—that of digestion, and that of respiration. You will recollect the notions of the ancients with regard to the former, who generally imagined that the food was prepared by putrescence or concoction, to which Erasistratus afterwards added a muscular force.* But neither putrescence, concoction, nor grinding, could ever explain how a variety of different substances are all converted into one kind of fluid, called

* Cicero, De Natura Deorum, lib. ii. cap. xxv. gives alternate contractions and dilatations to the intestines, for propelling the food.

Chyme, until the chemists, from frequently observing the processes of their laboratories, began to suspect that a certain fluid was secreted in the stomach, possessing the properties of a chemical solvent. Boyle and Ray ascertained its existence; Grew proved that it did not act upon living bodies; and others observed, that it varied according to the nature of the food and state of the stomach; that it was different in different animals, and even in the same animal at different periods;—facts which have certainly contributed much to explain the several phenomena of digestion.

Respiration was a function still more obscure, and its use in the system more beyond the reach of a common observer. The ancients imagined the Εμφυτον πυρ had many of the characters of a common fire; that air was necessary to support the combustion, to carry off the fuliginous vapours; and, in this way, by not only heating, but ventilating the system, became the regulator of temperature. Yet Cicero, whose notions were more refined, makes a marked distinction between common fire* and that which supports animal life. "The former," he says, "has a tendency to consume whatever it approaches; the

* De Natura Deorum, lib. ii. cap. xv.

latter, on the contrary, is vital and salutary, preserves, nourishes, augments, sustains, and endows with sensation. This species of heat is diffused through all nature, is the source of fluidity throughout the universe, is in a sensible or latent state, intimately combined with every other body, and even with the air, which, according to him, is the coldest of all bodies. This air, by its tenuity, and that heat with which it is combined, furnishes the vital spirit to animals; while the lungs, by their spongy texture, are admirably calculated to receive and distribute it through the system by respiration." From this language of Cicero, one might at first be inclined to believe, that he was acquainted with latent heat, and that the evolution of this heat, in passing through the lungs and the bloodvessels, was the principal cause of animal temperature. But his random expressions are so vague, and so evidently founded upon the hypotheses of the stoical philosophy, that we must, in justice, ascribe this discovery to a later period.

Our countryman, Mayow*, was the first who had accurate ideas on the subject; he proved from a number of well-conducted chemical experiments,

* Dr. Hooke has likewise some claim.

that the air was a compound, and that it was only one of its constituents that supported life. He proved likewise, that the same constituent, and no other, supported combustion, and that the temperature of animals was nearly in proportion to the quantity of air which they respired. From these facts he concluded, that the function of respiration was the principal cause of animal heat. On observing that the same aerial constituent, which supported combustion and animal life, was what converted potash into nitre, he chose to call it *nitrum aereum*, or aerial nitre, in order to distinguish it from the nitrate of potash, which, in his language, is the *nitrum fixum*, and, at the same time, from the nitric acid, which, in his language, is the *nitrum acidum*. Observing farther, that the *nitrum fixum*, or nitrate of potash, changed the colour of the blood from black to red, he endeavoured to explain the change of colour which the blood undergoes in passing through the lungs. In that passage, he supposed it to combine with his nitro-aerial particles, from the air which we breathe; and knowing that a regular and constant supply of fresh air is necessary to life and the due performance of the different functions, he inferred, that this regular supply of his nitro-aerial particles was the principal intention of respiration. To ob-

viate an objection that arose from the general opinion of his time,—that the motion of the lungs, induced by respiration, was chiefly designed to promote the circulation, he observed, that the circulation of the fœtus was carried on without any assistance from the lungs, and that though our breathing be suspended for a while, the pulse does not stop.

His nitro-aerial fluid was afterwards discovered in a separated state by the celebrated Priestley, and, after assuming different names, is now distinguished by that of Oxygen, or Oxygenous Gas. By the known properties of this gas, and by his discovery of latent heat, the late Dr. Black was able to throw additional light upon respiration and animal heat.

From this simple statement of facts, it must be obvious how much physiology is indebted to the chemists; and it is natural to expect, that much additional and valuable information may yet be derived from their future labours, provided they continue within those bounds which nature has prescribed to their researches. But, as chemical science can no more explain the properties of a circle, than mathematical reasoning the effervescence of an acid and alkali, they ought to recollect, that every science has its limits, and can only be useful when it is con-

fined to its proper sphere; and they should not proceed, as the mathematicians once did before, on the foolish hypothesis, that their science can explain every thing; nor, like a geographer, who, from knowing only a country or two, thinks himself qualified to give a map of the whole world. These observations are the more necessary, as some chemists have begun to imagine, that a vital principle has no existence; that all the phenomena of living bodies are the effects of chemical combinations; and that a more perfect combination might produce those phenomena in nature which we ascribe to the providence, wisdom, and the boundless power of the Author of all things. As these speculations are founded merely on gratuitous hypothesis, and affect ultimately, not only the religion, but morals of mankind, we ought to be guarded as to the motives whence they proceed. It is very evident that they have not for their object, either the truth, the advancement of science, or the interests of society; they remind us rather of the petulant boastings of a Paracelsus, who talked of prolonging life as he pleased, and, for certain reasons known to himself, of propagating the species without the intercourse of the two sexes.

But, to leave the dreams and idle visions of this fanatic, let us now see how much better founded are several pretensions of some of our physiological chemists, and whether the existence of some other cause, besides these chemical affinities, be not necessary to account for that combination and arrangement of parts which we observe in the animal structure.

When we observe the number of bones, joints, cartilages, veins, arteries, lymphatics, glands, nerves, ligaments, and membranes,—all of them differing from one another, all of them, however, of determined shapes, situations, and uses, and all of them growing at the same time;—when we see the number of chemical processes by which they are formed, differing in kind, but not interfering; or similar in kind, but producing works of a different form; and, although contiguous, always distinct in their operations; when we see the same chemical processes, employed in the other half of the system, performing the like variegated works in the same way, and in the same time; when we see them change and succeed one another according to the stated periods of life, and yet all their actions regularly co-operating, all of them dependent on one another, all of them contributing to one end, all of them constructing one whole, to be subservient to one will, and

obedient to one mind, can we suppose that this whole is without a plan, that this plan could have been formed without great wisdom and foresight? But this wisdom and foresight we must ascribe to the chemical affinities of the air which we breathe, and the food and drink by which we are nourished. If they be the sole organizers of our bodies, we must ascribe to them even much more;—we must give them the power of varying their work according to pleasure, and constructing, likewise, by the same affinities, the numerous species of animals and plants;—of preserving the regular difference of sex; its stated proportions between males and females, with all the desires, appetites, and passions, that are the concomitants of such distinctions.

We must likewise suppose, that these chemical affinities of our food and drink, and the air which we breathe, have an accurate knowledge of different countries, are acquainted with the various seasons of each, and that, occasionally, their repulsions and attractions extend through a space of some thousands of miles, driving animals from distant climates, repelling others in an opposite direction, and, at last, sending all back to their home at a stated period; as we see is the case with birds and fishes, and, in lesser degrees, with quadrupeds of passage.

As they are conceived, on this wild hypothesis, to have formed a Homer, a Virgil, a Milton, and a Newton, the conclusion must be, that they form the faculties of memory, imagination, and reason, in the highest possible human degree. And when we are brought to believe this, it cannot surely be difficult to imagine, how all our associations of ideas, and their connections with arbitrary signs, should only be a sort of chemical affinities; and we need not be surprised to see the processes of the laboratory exhibiting all the symptoms of passion, desire, and appetite; discussing moral and religious subjects; pretending to great skill in philosophy, and forming new models of empires. Such are the strange and singular consequences of that theory, which ascribes the organization of the structure to the chemical affinities of those materials of which it is composed.

The result is so absurd, that, with all their reluctance to admit the existence of a living principle, distinct from matter, many of our physiological chemists, with the French at their head, are begun to be ashamed of it. They are ready to acknowledge, that the laws which regulate animated bodies, are perfectly distinct from those which are found in chemistry and mechanics; they call them the laws of living matter of organized bodies; as if the matter

of organized bodies were some peculiar species of matter, distinct from the gross and sensible materials by which the organized body is nourished. The ground-work here is the same as before, and leads precisely to the same conclusion, that there is nothing like a soul in man: The language is only a little varied, and a little more accommodated to vulgar prejudices, for the purpose of better concealing the sophistry.

But, to take another view of the subject, let us put the question, To what do all these reveries tend, and what do they prove? Nothing but this, that some of our physiological chemists are beginning to wander from the true paths of genuine science, and fancy they are making important discoveries, in ascribing to these chemical affinities the properties of life, and the attributes of Deity,—a discovery that ranks, in my opinion, in the same class with that of the most superstitious and vulgar, who ascribe the most striking phenomena in nature to a certain description of silly old women whom they call witches.

That both chemical and mechanical powers are employed in the system, as operative agents, cannot be denied; but as they are always observed to act upon a given and specific plan, we must conclude, that, in the execution of the plan prescribed, they are direct-

ed by some other agent, which confines their operations to certain forms, situations, magnitudes, and periods of life.

This agent, philosophers have chosen to distinguish by the name of vital principle. Cicero has called it the *Principatus*, or the Ruling Power,* the Greeks termed it the Ἡγεμονικὸν—Van Helmont has called it *Archaeus*—others name it the *Anima* or Soul; but by whatever appellation it is known, the most celebrated naturalists, as well as anatomists, as Harvey, Malphigi, Lyonet, Bonnet, Trembley, Baker, the late Dr. Hunter, and many others, have shown its vast influence in the system, and proved, from a number of repeated observations and accurate experiments, its peculiar powers in a great variety of different animals. From what they have done, we can hardly help expressing our surprise, that important inquiries of this nature, begun and carried on by the most eminent anatomists in Europe, should, in some measure, be totally laid aside, and have given place to the theories of men, who had studied the animal economy in the closet, and who dreamed that matter was regularly subjected to the same laws, whether in the living body or the laboratory.

* De Natura Deorum, lib. ii. cap. xi.

This species of philosophy, says Dr. Hunter, has prevailed in many parts of physiology, and makes up a great part of what has been taught as sound and useful physiological learning: The consequence has been, that one thing of peculiar properties and powers has been explained by another of different properties and powers, as absurdly as if colours had been explained by sounds. But animal functions, he adds, generally speaking, are like nothing to be found in the works of art, or where there is not animation and life; and had physiologists spent that time in making accurate observation upon animals themselves, which has been thrown away upon mechanical and chemical visions, by this time we might have understood animal principles and processes much better than what we do now.

To confirm this reasoning, I would here ask, if, without experiments or observations on the living body, mere chemical and mechanical reasoning could ever have informed us, that a new tail will grow to the lizard, and a new head to many of the mollusca after the old ones are struck off; or could they have foretold, that when the claw of a lobster, a crab, or a craw-fish is destroyed, the remaining phalanxes shall drop off at the fourth joint, and that then, the animal, by its vital powers, shall reproduce an

entire limb, such as the former; or could they have foreseen, that the large bone of the human leg may die of disease, a new one occupy its place, and this, notwithstanding that the person affected should all the time never be entirely prevented from walking? Such are a few of the common specimens of that kind of knowledge, which some physiologists would have us to renounce for what Dr. Hunter not improperly denominates, their chemical visions. I hope it is unnecessary to warn you of the consequences. As the living principle has already become the subject of experiment and observation, and methods pointed out by which its properties, its powers, its functions, and its modes of action may be ascertained, I shall leave you to judge how far it is proper to turn from a field of such useful inquiry, merely because the fashionable vulgar, among our physiologists, do not countenance it. But such opposition has not been peculiar to the vital principle: the circulation discovered by Harvey was hooted and ridiculed in the same way, because the fastidious pride of anatomists, the fashion of the day, and their tender attachment to their own theories, would not permit them to examine the facts on which it was founded. Even chemistry itself, now so vainly proud of her physiology, experienced at one time a similar treat-

ment from the mechanico hydraulical physiologists, who talked with contempt of her acids and alkalis, because they were likely to drive from the stage their diagrams, postulates, and calculations, that so long had instructed and delighted the vulgar.

General knowledge alone can fully prevent these ridiculous prejudices, that naturally arise from allowing the mind to be wholly engrossed with a favourite science. In that situation a man must necessarily see things through a false medium. The chemist can only see his affinities, the geometrician his mechanical laws, and both must resemble the blind man, who, judging of visible objects by the ear, concluded that colours were a species of sounds, and from what he heard of the nature of scarlet, imagined it something like the blast of a trumpet; nor was this misapplication of a sense attended with more palpable absurdity, than the application of one science to explain and illustrate the principles of another.

It is a most singular and curious fact in the history of anatomy, that geometry, chemistry, and the vital principle of Helmont and Stahl, have all three been occasionally rejected from philosophy, because each in their turn, when they got into power, aspired at the most despotic authority, attempted to

explain the whole functions of the animal system in their own way, would allow no other a share in the merit, but, like one sense trying to perform the duties of the whole, always led to absurd conclusions, in which the most patient and stupid credulity could hardly acquiesce.

These failures should serve as a hint to modern physiologists, that the different functions of the animal system are not to be explained upon the principles of any one science. Nature is not to be dragged into our theories, nor restricted to our rules, and, therefore, if we mean to investigate the truth, we must not assume the tone of authority, and dictate to her, but mark her laws, observe her operations, and try to distinguish in what cases she principally employs her chemical, mechanical, and vital powers. Perhaps she may even employ more than we are aware of. Much is reserved for time and for chance, and much too it is likewise certain we shall never know. For to comprehend whatever relates to the animal system, is to comprehend the Being who made it. Now these hopes we can hardly entertain; for, although we can trace the chain of gradation from the meanest reptile, upwards towards man, yet between man and the Sovereign of the Universe, the distance is immense.

I have now finished this introductory part of the course, in which you have had a general view of the animal system, and seen a sketch of the leading discoveries made in anatomy, with the arts and sciences, that have contributed to their improvements. As a preparation, and to give an interest to those minute and detailed descriptions, on which we are to enter, I thought it necessary. The principal facts will be highly useful, as heads of arrangement, in collecting your future ideas on the subject; and, if you observed that I ventured at times to mark the limits, within which the auxiliary sciences ought to be confined, you must not understand me, as if I meant to lay any restriction upon you. As your knowledge increases, you will think for yourselves; I wish you by no means to subscribe implicitly to my opinions—such unbounded confidence could do no good to me—it would not reflect any credit on your own understandings, and it never would promote the interest of the science, which with you and with me ought to be the great object at heart.

COMPARATIVE ANATOMY.

LECTURE FIFTH.

COMPARATIVE ANATOMY.

ANATOMY, which literally signifies Dissection, when employed as a mean to investigate the structures of inferior animals, is styled COMPARATIVE. The term has its origin from the numerous allusions that, in these investigations, are usually made to the human structure. The objects of such inquiries are various: We dissect these animals to derive, by comparison, additional information respecting the different organs and functions of the human structure; and, therefore, dissect them not only to be better acquainted with the species to which they belong, but to correct or confirm our observations with respect to a species which we have seen, and which, in order to be better under-

stood, requires much collateral illustration;—we dissect them, also, to learn, from analogy, the nature of a species which they resemble, but which we have not seen, nor have ever had in our power to examine;—we dissect them in different periods of life, to observe the changes in structure and form which they undergo from birth to maturity, and to mark the relations between these changes and the several changes of disposition, habit, and instinct. For the same reason, and to throw an additional light upon Medicine and Natural History, we dissect them in all the various states of health and disease, that we may know from their outward symptoms, what are the changes taking place within, and thus be enabled to learn from analogy, to retard, alleviate, successfully to resist, or remove diseases in ourselves and them.

To ascertain with still more accuracy how far a function depends on the form, the structure, the position, or connection of an organ, or how far it depends upon that principle which directs the organ in all its operations, we dissect and compare animals belonging to different genera, to see whether similar functions may not be performed by organs of very different kinds; whether in cases similar to those in which a man uses the hand, the

elephant may not use his proboscis, the swallow his bill, and the beaver his teeth;—or we dissect them, in order to know whether functions and instincts, specifically different, may not be connected; and particularly where voluntary organs are concerned, with forms and structures remarkably similar, as we see on comparing the toad and the frog, the hare and the rabbit, the carrion and the granivorous crow, and various species of the same genus, distinguished more by habits and instincts, than by obvious features of form, or of structure; a circumstance that naturally occasions this reflection, that a difference of habit, disposition, and instinct, may as often originate from insensible causes as from many of those prominent characters that forcibly obtrude themselves upon our senses.

Lastly, we are led to extend our inquiries to every genus and species of animals within our reach, when we wish to be informed respecting the beautiful gradations in nature, to draw conclusions with regard to the animal kingdom at large, or to ascertain whether the fossil-remains of animals belong to the species that now exist, or to genera and species that have long been extinct: An inquiry, that naturally and necessarily carries us into geology, to consider the past revolutions of the

globe, its climates, its surface, and its productions, that supported inhabitants so different from the present.—This extension of research becomes the more necessary, as general conclusions from partial observations are the bane of philosophy, being only foundations for idle hypotheses, and abstract discussions that divert the mind from attending to the actual processes of nature, that stir up within it the spirit of controversy, and direct its whole force to the study of logical distinctions and subtilties, as often employed to obscure the truth as detect error.

In former days, when anatomists drew their general inferences from examining the structures of one or two species, they were not unfrequently opposed by others, who reasoned from the structure of a different genus ; and thus physiology, instead of furnishing us with new truths or certain conclusions, furnished us only with new sources of wrangling and dispute, when each combatant, in the place of appealing to Nature herself for additional information, appealed to Hippocrates, Galen, or Aristotle, or to some other leader who had indulged as much in hypotheses as they did themselves. Thus, prior to the time of the celebrated Harvey, how various the notions that were entertained of

the motion of the blood,—with what acrimony, learning, and subtilty was each supported,—by what conjectures, hints, and probabilities,—by chance, approaching at times to the truth, but as often flying off in the opposite direction. Harvey, who saw that experiment alone could decide their controversies, had recourse to the aid of Comparative Anatomy,—dissected numerous species of animals,—and though amidst the sneers, the scorn, and abuse of his contemporaries, at last made the great and immortal discovery of the Circulation,—silenced many of their groundless disputes, and laid an entirely new foundation for Physiology.

Since that period, every anatomist has seen the importance of Comparative Anatomy, and been forced to acknowledge, that scarcely a problem in physiology can be solved without it; and it must be obvious, that every organ should be accurately examined in varieties of form, connection, structure, and relative position, before we can venture to assert with confidence, what is essential, or what is not essential to its functions. At one time, anatomists were surprised to find a liver on the left side, as if the liver upon that side could not perform its functions as well as upon the right. Its situation, its form, its proportions, its several aspects,

and supply of blood, are different in the fœtus, and in the adult of the human species; and, on looking into birds, we find it there equally divided between right and left; and oftener upon the left than upon the right in the class of fishes. The forms of the body and the modes of life in these two classes being evidently different,—"a leading specialty," says an eminent anatomist, "draws after it a great many more*."

From the numerous advantages thus derived from Comparative Anatomy, and from its being generally acknowledged as the basis of all rational deduction in physiological investigations, it may seem surprising that it is not more generally studied, and particularly as every distinguished anatomist, whose name is known in the records of history, has set the example †, and strenuously recommended it as the only source from which we can derive any explanation of the modifications of the animal structure, or any clear and accurate idea of the functions of organs.

It exhibits a view of the animal creation so widely extended and so infinitely varied, that there

* Monro's Preface to his Comparative Anatomy.

† Haller, under the word HALLER in Bibliotheca Anatomica.

is no diversity of taste, genius, or habit, that may not find suitable objects to attract the attention, either in the way of instruction or amusement. Anatomists, therefore, amidst so wide and unlimited a range of animated beings peopling the air, the waters, and the earth, have naturally selected from the vast immensity, the particular objects which time, inclination, or opportunity led them to examine; thus some have principally directed their attention to two or three species, some to the prominent character of an order, as Conrad Peyerus to the organs of digestion in ruminating animals; some to varieties of genera and species; some to the study of the larger animals; and some, as Swammerdam, Lyonet, Bonnet, Trembley, Baker, Needham, and Dellenius to the study of animals, that can properly be examined only through the microscope, while Blasius and Collins, of a different cast, have contented themselves with collecting and publishing the observations that were made by others.

Of these observations many are found in the *Transactions of the Royal Society*, and in the *Memoirs of the French Academy*, two learned bodies who have always countenanced Comparative Anatomy, and been fully aware of the numerous advantages that naturally result from it. Of the indi-

viduals who have turned their attention to this subject, no one perhaps was ever more sensible of its importance than the great Haller, without exception undoubtedly the most learned and the most indefatigable of all anatomists, and yet, at the same time, an eminent botanist, a philosopher, a divine, a poet, and a statesman. In his *Elements of Physiology*, a work consisting of eight volumes 4to, and his *Opera Minora*, consisting of three, he has collected from Harvey, and others of his predecessors, almost every important observation that relates to the structure or functions of animals, examined the facts on which they were founded, and has added many that were new of his own. From the natural influence of such an example, followed by d'Azyr, d'Aubenton, and others, and so forcibly recommended by the numerous proofs which Buffon has given of the additional interest and improvement which natural history may derive from such studies, one should have imagined that many others would have eagerly followed him in the same path to fame. But Haller's works unfortunately being in Latin, and not translated, they are more generally spoken of than read. Yet read or not read, as nothing of the kind had ever thrown so much light upon physiology, they certainly procured to him, and previous

to his death, which happened in December, 1777 deservedly the first reputation in Europe.

In mentioning Harvey, and some of the eminent characters abroad, who have advanced this branch of anatomy, I should be unjust to my own country, were I to forget an ingenious Essay, written with great ability and spirit, and strongly recommending Comparative Anatomy as of first-rate importance to every branch of the medical profession: This elegant Essay, bearing to be the work of a physician then lately deceased, appeared in London in 1744, with a preface by a gentleman to whom the publisher had submitted the manuscript, and who strenuously advised the publication, as containing many useful discoveries, and as being the production of some great master, whose learning and modesty seemed not to be inferior to his capacity. It turned out afterwards, that this Essay had been copied from the Lectures of Dr. Monro, the great founder of our Medical School, and who continued to survive its appearance above twenty years, dying in 1767, ten years before the illustrious Haller. In sixteen years after his death, the same Essay, accompanied with the original preface, with several additions, his name prefixed, and a copious index, was re-edited by his son. Yet, notwith-

standing this high authority, and the merit of the work, in which he urges the beauty, the extent, and utility of the science, and the flattering prospects which it holds out of new discoveries and increased reputation, the interesting study of Comparative Anatomy has hitherto been prosecuted only by a few, although these few have been men of the first distinction and talents; men who have thrown much light on natural history, and even on geology, and who are avowedly either the sole or the principal discoverers of the numerous facts that contribute to explain the animal functions, and establish the principles of physiology.

With all these inducements, with the frequent and even daily opportunities of dissecting animals of various descriptions, and preserving the health of the useful and domestic, in which so many are deeply interested, what can be the cause that it has not been more generally cultivated? The explanation seems to be this,—Anatomy is an art, and, like any other art, is not to be learned either from pictures or verbal descriptions: those who would study it, must see it practised; they must see the forms, magnitudes, positions, proportions, and connections of the structures and organs as they are in nature. No figures or verbal descriptions can

ever compensate for the want of the originals; they give not the same relish nor interest, nor afford the same correctness of ideas. Even when accurate, they but assist the imagination to conceive the things which they represent; and if they be otherwise, as they frequently are, they tend to mislead it, and become, not unusually, the strongly fortified depots of error. In short, at their best, they are only shadows in place of the substances, and if they be faulty, they are worse than shadows, because they are shadows without any substance, or prototype in nature. To illustrate the general scope of this reasoning, let any one read the history of a country, study its maps, and afterwards visit the country itself. If he travel through it with any attention, he will generally find it a different country from what either his reading or his maps led him to suppose. His visit will produce livelier impressions, a deeper interest, and more accurate conceptions; it will even give an additional relish to the perusal of his history; and his map will reflect a new kind of light, and assist in furnishing him with new kinds of views: both must then be better understood, more easily consulted, less apt to mislead; and thus becoming much surer guides for refreshing his memory and enliven-

ing his fancy, cannot afterwards fail to recall a number of past associations that were formed in his tour, and to fill up more satisfactorily the several vacancies of his recollections. Yet, notwithstanding that maps and histories give imperfect information, compared to that which is directly and forcibly impressed from the originals, still histories and maps, relating to those species of objects with which we are familiar, convey more clear and accurate ideas of the things intended, than anatomical descriptions and engravings, that are meant to convey ideas of things of which we had not previously formed a conception even by analogy. It is no wonder, then, that a general taste for Comparative Anatomy has never been communicated through these channels, even when attempted by such men as Harvey and Haller, men of the most indefatigable industry and transcendent genius.

The plan that is now generally approved is more likely to succeed,—that of exhibiting the originals themselves, where they can be procured, and demonstrating by dissection the structures of different genera and species in a series of lectures, while these lectures are further illustrated by various anatomical preparations, sometimes of species rarely to be found, but which chance occasionally throws in the way,

and which can be easily preserved in museums By such lectures the celebrated Cuvier, the author of five volumes octavo, on the Comparative Anatomy of Animals that now exist, and of four in quarto, on the Fossil Remains of many a species that is now extinct, has not only extended his fame throughout Europe, but given a degree of eclat to the science that it had not before. The British Parliament, too, has been roused, and, aware of the advantages to be derived from disseminating this species of knowledge, has purchased Mr. Hunter's museum, chiefly relating to Comparative Anatomy, and presented it to the Royal College of Surgeons, where it is to be hoped that Mr. Abernethy, appointed the lecturer and the professor, will still continue to exert those talents for which he is so eminent, to raise its reputation and extend its usefulness throughout the empire. I have no doubt that it will soon attract a very general attention in Ireland, as Mr. Macartney, so well known for his acquirements in this branch of science, has lately been elected professor of anatomy in Trinity College, Dublin. It is already beginning to create an interest in some of the United States of America; and Dr. Mease, who has delivered a course on this subject in Philadelphia, has sent me his introductory

lecture, which displays much reading and research, and highly proper views of the science; although, from the circumstances in which he was placed, he was much confined in his illustrations, to veterinary medicine; which was certainly like stripping a luxuriant plant of all its promising branches but one, that it alone might abstract and absorb whatever nourishment should enter by the roots, or ascend by the trunk. This practice of communicating veterinary science, through the medium of demonstrations and lectures, has a long time been known on the Continent; while another practice, that of dissecting the lower animals as substitutes for men, may date its origin from a high antiquity, though now fallen much into disuse, from the greater opportunities of studying from the human body itself. A third practice, that of dissecting a variety of animals, with the view of improving natural history and establishing the principles of physiology, though privately pursued by several individuals, has seldom till lately been generally recommended by a course of lectures. Among the first who made the attempt, may probably be reckoned the great founder of our Medical School, Dr. Monro *primus*. He began these lectures prior to the middle of the last century, in which course he was followed by his son, a very

distinguished successor, and an eminent writer on some branches of Comparative Anatomy. If their lectures failed to produce the effects that were intended, to rouse the energies, and to awaken a spirit of inquiry among their pupils, the failure certainly was not owing to a want of zeal, or to any want of ability in the teachers; other circumstances easily account for it. Their lectures were few, and from want of preparations, so limited in their range, that their pupils had only a partial glimpse of the wide and the varied field that was before them. They, besides, were delivered as merely an appendage to a different course, which, by that time, had continued for a period of nearly six months. Many of the pupils who had finished their studies, were returning to their homes; those that remained were impatient to follow them; and, seeing their companions dropping off daily, got weary and exhausted, and ceased to feel that glow of enthusiasm with which they commence a new course of studies, when every one is fresh and in spirits, and challenging his fellow, by precept and example, to contend with him in laudable exertion.

We begin this course, I would fain hope, in different circumstances; with a greater variety of illustrative preparations, that enable us to take a

much wider range—not a course of four or five lectures—not confined to the demonstration of a few organs in two or three animals—not delivered to those who are indifferent to the various objects which it embraces—not to those who are impatient to follow their companions, to return to their homes, their friends, and amusements. I shall flatter myself, that those who are now intending to enter upon this study, are every way prepared to enter upon it with that arduous and steady perseverance which seldom fail to be crowned with success in any rational or honourable enterprize.

Permit me then to explain more particularly the views I entertain of its utility, and to point out the ways in which I think it may, as a branch of liberal education, be of high importance to men of various professional descriptions. To all belonging to the medical profession, whether surgeons or physicians —to all naturalists, whose taste may incline them to the study of zoology—to all who are concerned in the health and preservation of valuable animals—to the lawyer, who attends to the nature of evidence in criminal trials—to the moralist and logician, who view the faculties of the mind in the abstract, without reflecting upon the powerful re-action of the organs by which it operates, and by which it is often

operated upon—to the physico-theologist, who is anxious to witness the strongest proofs of any that are furnished by the works of nature, of the existence and power of the Deity, of his omniscience, his omnipresence, his varied operations, and his universal superintendence—and, lastly, to the inquisitive geologist, that delights in tracing the great physical revolutions of the globe, by studying the fossil remains of animals that at one time had been its inhabitants, when it presented a different aspect and had different climates from what it has now.

In adverting to each of these, in their order, I shall begin with mentioning some of the principal advantages which those of my own profession may derive from it. It was by studying Comparative Anatomy, and dissecting animals that bore the nearest resemblance to man, that all the earlier physicians and surgeons, down to the end of the fourteenth century, excepting Herophilus and Erasistratus, who, under the protection of powerful princes, had sometimes permission to dissect criminals, could ever have acquired any thing like precise ideas of the structure and functions of the human body. It was almost entirely from this source that Galen collected all the information that appears in his valuable work on Anatomy, a work

that, in the opinion of Portal, one of the most learned anatomists in Europe, is greatly superior to many compilations of the present day. This, while it reflects credit upon Galen, is a sort of reproach to those of our own times, whose ignorance renders them the dupes of such impostors as choose to obtrude their meagre compilations for new and improved systems of anatomy.

The descriptions of Galen, though taken from Quadrupeds, are, in many repects, so generally applicable to the human species, that had we not been assured of the contrary, we should have sometimes been inclined to believe, as several have done, that he had actually dissected man. But the strong prejudices against the dissection of the human body rendered that impracticable. For even he, though physician to an emperor, and the friend of a consul who witnessed his dissections, is under the necessity of advising others to go to Alexandria to obtain the sight of a human skeleton, having learned by experience that anatomy was not to be acquired by reading or oral description.

These prejudices still continue, to a certain extent, in many countries, and even in our own; but not so unsurmountable as they were in his time among the Greeks, the Romans, and others. Such

prejudices now are not against dissection in general, but against the dissection of relatives or friends. Viewed in the abstract, the art of dissection is highly approved, taught under official authority, and everywhere acknowledged the primary source of that information by which we are enabled to combat successfully the attacks of disease, to prolong the health of our citizens at home, and preserve the lives of our generous and gallant defenders abroad. Many of these, by the improved operations of Surgery, directed by Anatomy, have recovered from wounds for which former periods could think of no remedy; and many, perhaps, by the advantages of medical aid, are now reserved, as Nelson once was, to acquire new laurels, to gain new victories, and to add new honours to the arms of their country.

In situations where these prejudices are rather losing than acquiring strength, it would be absurd to substitute entirely the dissection of quadrupeds for that of man; but there may be situations, and there are situations, where a medical gentleman can have no opportunity of examining the structure of the human body; where his recollections of that structure must become faint, his ideas vague, and where he consequently must lose that confidence, both in prescription and in operation, which he once

had. In such situations, Comparative Anatomy is an object to him of the utmost importance. It preserves alive his former recollections of the human structure, exhibits similar organs and functions, extends his ideas of the animal economy, and occasionally corrects the indistinct notions which he had received from lectures or books. If he be engaged in surgical practice, it makes him familiar with the nature of the parts on which he has to operate, with their connexions, their relative situations, and mutual dependence. An artery, a vein, a nerve, and an absorbent, have a similar appearance and similar functions in the warm-blooded quadrupeds that they have in man; and he who can readily dissect and distinguish them in the one case, can do it in the other; so that he who can with dexterity and skill perform operations on the lower animals, is not ill-prepared to perform the like upon man himself. Some modifications are no doubt requisite, from the difference of circumstances, but a knowledge of these is easily acquired, and may be learned by a person acquainted with the general structure, from verbal descriptions.

From the numerous figures of the lower animals which were published by the one, and the splendid museum left by the other, it appears that both

Cheselden and Hunter were ardent enthusiasts in Comparative Anatomy, and yet these two have never been surpassed, if they ever have been equalled, in the skill and dexterity with which they operated on the human body. Their success, however, is not to be entirely imputed to that knowledge which in these investigations they had acquired of the animal economy. By their various dissections they became acquainted with various modes of performing operations, and, constantly engaged, acquired an expertness in the management of their instruments, which all have admired, but few have taken the trouble to imitate. The want of practice in the use of the instruments is one of the evils at this day attending on surgery. In studying almost every other art, a young man, from the date of his indenture, begins to handle and work with the tools that are appropriate to his profession, and, at the expiration of his apprenticeship, is generally supposed to be as dexterous in managing and applying them to various purposes as the master himself. Now this happens to be seldom the case, and cannot well be the case in surgery; the master cannot afford to his apprentices the same opportunities,—he cannot dispose of his patients at pleasure, nor will they, where they think their life is in danger, submit to

operations by an apprentice that is thought inexperienced. In most operations on the living body, the master, therefore, can only instruct them by his example in the use of their instruments. To acquire the practical management of these, they have usually recourse to the dead body; and yet it is only in particular situations that dead bodies can be procured, and even these are procured with difficulty, often from a distance, and at great expense. Comparative Anatomy then becomes the only alternative; the lower animals may be procured at all times, in all places, and without any inconvenience or obstruction. By dissecting and practising operations upon them, a knowledge so desirable, essential and necessary, as a thorough acquaintance with the management of the instruments, may be gradually acquired; and, what is more, such operations, in many respects, may approach nearer to those performed on the living body, than those which are practised on the dead human subject. In the dead body there is no hemorrhage to conceal the parts or retard the operation, no arteries to be suddenly tied, no muscles to give any kind of disturbance by their action, and no nerves to produce pain, writhings, and convulsions. In short, bating the external form and internal structure, no two bodies

can be more unlike in the other phenomena which they exhibit, than a dead and a living, even though they be of the same species. So let not the young anatomist and surgeon despise this road to professional improvement. They need not be ashamed to tread in the paths where Harvey and Haller, and Cheselden and Hunter have gone before them. Those who neglect such favourable opportunities to become acquainted with the use of their instruments, are apt, when engaged in any operation, if they cannot contrive some anomalous appearance in the structure, to blame the instruments for any unforeseen or untoward circumstance; but, whatever defects they may point out, the event in general will only serve to remind the bystanders of the common observation—that a bad reaper never yet got a good sickle; as if the instruments were entirely in the fault, they immediately set their invention on the rack to contrive new ones. Hence the explanation of that immense variety of instruments, as Staffs and Gorgets, for performing the operation of Lithotomy; an operation which ordinary instruments were accustomed to perform with admirable success when put into the hands of a Cheselden and a Hunter. How comes it then that these instruments have

lost their power, their skill, and reputation? The truth is, they never deserved any; they owed what they had to the hands that held them, and the heads that directed them; and such hands and heads might be more frequently obtained by repeated dissections, and frequent operations on the lower animals. By these observations I mean not to insinuate that surgical instruments are sufficiently improved; the very reverse I believe is the case; though these improvements should come from persons who are thoroughly conversant with the nature of the instruments, and the uses to which they are applied. All men must necessarily handle them but awkwardly at first, and yet then it is they are most inclined to invent new ones. When they have served a regular apprenticeship in the use of what they have, they begin to discover that the fault was not so much in their instruments as in themselves. Whatever then the old and experienced surgeon may do, the young surgeon should always be cautious how he complains of the customary instruments, as his objections are liable to more interpretations than one.

In another point of view, Comparative Anatomy is of equal interest to the surgeon and physician, it being the foundation of most of the physiological

information communicated in lectures upon the Theory and Institutes of Medicine. These lectures being meant to contain the results of all the various observations and experiments relating to the solids, fluids, and functions of the animal structure; but these results, though accompanied sometimes with a few remarks, are rarely accompanied with any demonstrations; for not only the pupils, but the lecturer himself, must often receive them upon bare report, without knowing, in many instances, the motives by which the reporter was actuated, or his qualifications for giving a fair and accurate statement. In many cases they are therefore left to form an opinion of structures and functions, not upon evidence weighed and examined, but on simple assertion, without any regular means of ascertaining whether it was founded on hypothesis or fact. Thus Haller, the most learned of all physiologists, in a case beyond the reach of his own observations, by trusting the assertion of Sir John Floyer, has maintained that the pulse increases in frequency from the Pole to the Equator, though Sir John, afterwards changing his hypothesis, published a table to shew in what manner its frequency increased through all the intermediate degrees of latitude, from the Equator towards the Pole. As such in-

stances of careless inquiry are rare in Haller, and a sort of novelties, I shall mention another:—In enumerating the authors that have contributed to improve anatomy and physiology, he informs us of two in the same page, whom he does not appear, however, to have read,—a Thomas Reid that writes Inquiries into the Human Mind upon the Principles of Common Sense, and a Bartholomew Ruspini that writes a treatise on the Teeth and Gums. Thus, writing on report, he was surely little aware at the time, that the Thomas Reid, whom he mentions so slightly, was a scholar and philosopher of the first-rate distinction, and one who now enjoys a posthumous fame that is likely to be as immortal as his own. But if Haller was liable to such errors in the few instances where he trusted to report, to what a number must they be exposed who have no other evidence on which they can reason? If Harvey had implicitly received the explanations which his master, Fabricius *ab Aqua Pendente*, gave of the processes which he saw in the veins, he had never made the immortal discovery of the circulation. But he wished to see them with his own eyes, and to see them operating; and, in making these inquiries, he found they were valves compelling the blood always to flow in the same direction through these ves-

sels. He proved this by his various dissections of the lower animals; for no man was ever a more ardent admirer than he of Comparative Anatomy, or felt such contempt for hypothetical reasoning, however ingenious. In his opinion, it was weakness of intellect only, a want of genius, and a despicable indolence that could render us content with any thing short of actual experiment and observation. He informs us himself that a common reproach thrown out against him was—that he dissected frogs, serpents, flies, and other vile animals; but he adds, that the more he laboured, and the more he was fatigued in these operations, the more pleasure he always received. I can easily believe that this was the fact. The dissection of a new species of animal must always present many phenomena, and new phenomena, on repeated dissections. In this way Comparative Anatomy becomes a source of continued novelty and endless variety, and yet he who pursues it, delighted sufficiently with observing the varieties that he partly anticipated, may often meet with facts which no analogy could have led him to expect, and which no human intellect could possibly foresee. Thus, in dissecting a live dog, Asellius, by mere accident, first saw the vessels that conveyed nourishment from the intestines. By a similar accident, Pecquet saw the ves-

sel which received that nourishment and sent it to the bloood. By a third set of accidents, and all in the opening of live dogs, a Dane, a Swede, and an Englishman, observed vessels arising from every part of the body, and sending more fluids into the vessel discovered by Pecquet. These vessels were not so much as suspected by Harvey; and yet the late Dr. Hunter of London, the late Dr. Monro of Edinburgh, and the late Mr. Hewson, by extending their researches in Comparative Anatomy, have proved them an essential part of the system in man, quadrupeds, birds, and fishes. By observations that were likewise accidental, many have discovered that the hair and some other coverings of animals, whether they were natural or artificial, have occasionally emitted electric sparks. By other, merely accidental observations, it has been discovered, that some species of animals can discharge strong electrical shocks, and have been found, on research, to contain electric batteries for the purpose. The most singular, however, of all these accidental discoveries, with respect to its consequences, was that of Galvani. Who, for instance, could have foreseen, when he was dissecting the limbs of a frog, and surprised at their tremulous motion, that this casual occurrence should immediately have led to the discovery of a

new fluid, a most powerful and general agent in nature? and who, even then, could have anticipated the consequences that followed, that by this fluid, Sir Humphrey Davy should have been enabled to discover a number of other substances, likewise general agents in nature, and by such discoveries annihilate a number of favourite theories, and establish a new era in chemistry? It would be easy to enumerate more, and a great many more, that have been made in a similar manner, and thrown much light upon Physiology. But though such discoveries have frequently been of the greatest utility, and can never be expected in forming a hypothesis, or in retailing the experiments of others, I would not recommend Comparative Anatomy merely from the hopes of occasionally stumbling on them. Comparative Anatomy is different from a mine of gems or a lottery. Independent of these casual discoveries, many of which may still be reserved for future inquirers, it never fails to afford adequate and certain rewards, to every one that with zeal and spirit turns his attention to it. It affords clear and ocular demonstration that all animals are constructed on the same general outline, and only varied as to class, order, genus, and species.

It points out many relations that subsist between the varieties of function and organs—between the varieties of organs and instincts—and between the instincts and external circumstances. It points out many relations between the forms and habits of the species—between the different organs of sense, and the objects that invite or threaten them from without—between certain appearances in the brain and the rapid or slow developement of the instincts—between the organs of digestion and the food—between the organs of defence and attack, and the corresponding dispositions—between the organs of respiration and the animal temperature—between the ratio of the brain to the spinal marrow, and the natural sagacity common to the species—and between that ratio and the power of reproduction or tenacity of life—between certain ramifications of the bloodvessels and the natural slowness or velocity of motion—between other distributions of the bloodvessels and the attitudes of the parts on which they are ramified. On the other hand, to prevent us from running into an extreme, from ascribing too much to the organs, and from supposing that the instincts, the habits, and characters of animals are, in all cases, to be regulated by them, it furnishes

us with instances, numerous and diversified, where similar functions are connected with quite different organs, and similar organs with different functions. The philosopher would err, who, from cursorily examining the outward form, or internal structure of the hare and the rabbit, should thence imagine that they have similar instincts and habits. He would err if he thought that the same individuals might not have very different instincts at different times, when they watch over and provide for their offspring, and when they repel them, cease to care for them, or even to know them. He who has studied the singular varieties of the human character, will certainly admit these must depend much less on any visible changes of the organs than upon the agent that secretly directs them and remains unseen. Even many changes may take place in the organs, and, by their reaction on the ruling agent, occasion many peculiar sensations, that cannot be traced up to their origin. Thus, what can be the cause that every individual of the same species emits a peculiar variety of effluvia, but some difference in the action of the organs? a difference, however, which we never can detect, either by dissection or by chemical tests, and should never have supposed,

unless the dog had casually informed us by his superior acuteness of smell.

Those who tell us that every prominent feature of our character is indicated by some variety of the skull, arising from modifications of the brain, seem neither to reflect on the powerful operation of moral causes, nor on that powerful reaction of organs that so frequently disturbs the functions of the brain, and when long continued, even alters its structure. When physiology is better understood, few will be deceived by such theories and fancies. It will be found equally hostile to the too easy credulity of ignorance, the dogmas of error, and the overweening conceit of the sceptic, who, with an intolerable degree of bigotry, frequently talks of established laws, as if all the various secrets of nature were unfolded to him, and he were the confident of the Sovereign of the Universe. But, before Physiology can be carried much farther, farther researches must necessarily be made in Comparative Anatomy, where much still remains to be discovered, much to be examined with more accuracy, and much still of the structure and functions of our own bodies to be further illustrated. If much interested, therefore, in this science, let us not be contented with the reports

of dissections by others. Let us carefully repeat them, if within our power. We shall generally find that many things have been overlooked—many exaggerated—others extenuated—and that the information which enters by the eye, and is proved by the touch, is very different from that which enters merely by the ear.

FINIS.

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